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IT is but natural that the rising generation of physicists faced as they are between the twin problems—first, of keeping themselves abreast of the growing development in the physics of elementary particles, and second, of the very rapidity and magnitude of this growth itself,—should find themselves in that peculiar position of not having a complete knowledge of the fundamental experiments of the giant pioneers in the field who by their assiduous and purposeful researches laid the true foundations of nuclear physics. One such pioneer was undoubtedly Ernest Rutherford.

To each generation of students “modern” physics essentially comprises the developments in the subject that have taken place within the immediately preceding, say, fifteen years, and, thanks to their teachers who themselves had learnt *their* “modern” physics perhaps fifteen years earlier, it may generally be assumed that an average college student of physics today is not fully appreciative of the work in atomic physics earlier to the discovery of the neutron by Chadwick in 1932.

It may pertinently be asked: How many students now attending colleges know about that basic discovery of Rutherford, accomplished fifty years ago, on the large angle scattering of  $\alpha$ -particles? Yet, indeed, it was this discovery which was chiefly responsible for all our modern ideas about nuclear structure and elementary particles. The experiment Rutherford performed was quite simple. Using a source of high-energy  $\alpha$ -particles emitted by a radioactive substance he allowed them to fall on a thin foil (silver or gold), and found that sometimes the  $\alpha$ -particles were actually scattered *backward*—rarely but certainly. Recalling this later in his life (1936), Rutherford said: “This was the most incredible event that has ever happened to me in my life.” He has described his immediate reactions in the following words: “It was almost as incredible as if you fired a 15-inch shell at a tissue paper and it bounced back and hit you.... On consideration I soon realised that this scattering backwards must be the result of a *single* collision and when I made calculations I saw that it was impossible to get anything of that order of magnitude unless you took a system in which *the greater part of the mass of the atom was*

*concentrated in a minute nucleus.* It was then that I had the idea of an atom with a minute massive centre carrying a charge. I worked out mathematically what laws scattering should obey and I found that the number of particles scattered through a given angle should be proportional to the thickness of the foil, the square of the nuclear charge and inversely proportional to the fourth power of the velocity.” These deductions were later verified by Geiger and Marsden in a series of beautiful experiments. And so it was that the nuclear model of the atom which is at the basis of all modern science was born. A single observation and its correct interpretation led to a revolution in scientific thought paralleled only by a very few such discoveries in the annals of science.

In the context of what has been said above the publication of the collected papers of Lord Rutherford under the scientific direction of Sir James Chadwick will be most welcomed by the scientific public. It will undoubtedly be a valuable addition to all scientific libraries and institutions. The primary purpose in this publication is to set up a visible memorial to one of the greatest figures in the history of early twentieth century science, and coming as it does immediately following the Jubilee Year of Rutherford's basic discovery of  $\alpha$ -particle scattering (1911) mentioned above, this memorial is dignified and at the same time most timely. The Collected Works will make it readily possible for the succeeding generations of young scientists to see what Rutherford did, to follow the development of his ideas, and to get at first hand some idea of the magnitude of his contribution to our knowledge of the physical world. As Sir James Chadwick remarks in his Foreword “No reader of these volumes can fail to be impressed by the vigour and directness of Rutherford's mind or fail to become aware that the pursuit of scientific truth was to him an activity of the highest intensity, and also a very personal activity.”

The volume under review, which is the first of the four volumes in this undertaking, contains 78 papers published during the period 1894–1906, that is, the early papers of Rutherford when as a research student at Canterbury College, Christchurch, New Zealand, he worked on high-frequency phenomena in electricity; his papers on the electrical conductivity of gases exposed to X-rays, which work was done in the Cavendish Laboratory during the years 1895–1898 when he became associated with

\* *The Collected Papers of Lord Rutherford of Nelson*, Vol. I. Published by George Allen & Unwin Ltd., under the Scientific Direction of Sir James Chadwick, 1962. Pp. 931. Price £ 6.6 sh.



J. J. Thomson; and finally his papers on Radioactivity published from the McGill University, Montreal, where Rutherford occupied the Chair of McDonald Professor of Physics from 1898 to 1907.

The reader naturally begins to study the first few papers of Rutherford with a sense of curiosity to find out how far the youthful experimenter displays in them signs of originality and independent thinking which are to become the outstanding characteristics of his later work. He finds that he is not disappointed. The very first paper on "Magnetization of Iron by High Frequency Discharges" shows evidence of the directness of the author's approach to the subject and his ability to go to the heart of the matter. His second paper "On Magnetic Viscosity" is noteworthy as it contains the description of an ingenious mechanical device which Rutherford called a "time apparatus", by which one could measure small intervals of time down to less than  $10^{-5}$  sec. Rutherford's first paper on radioactivity "Uranium Radiation and the Electrical

Conduction Produced by it" shows the directness and simplicity that he brings to his experiments leading to unequivocal inferences. "These experiments show" he records "that the uranium radiation is complex, and that there are present at least two types of radiation—one that is very readily absorbed, which will be termed the  $\alpha$ -radiation, and the other of a more penetrative character, which will be termed the  $\beta$ -radiation."  $\alpha$ -radiation became Rutherford's pet subject.

The papers appear in the chronological order of publication. While most of the papers are in English a few have been chosen from German or French versions as they contain additional material. To the present volume Sir Edward Appleton has written an introduction to Rutherford's early work in New Zealand and Cambridge and Professors H. L. Bronson and Otto Hahn have contributed some delightful reminiscences of Rutherford's Montreal period. The photographs of Rutherford and his collaborators and of some original apparatus of historic interest add value to the publication.

## A UNIFYING THEORY OF HIGH-LATITUDE GEOPHYSICAL PHENOMENA

THROUGHOUT the whole of the earth's exosphere, and through much of the underlying ionospheric region, the geomagnetic field exerts a strong control on the motion of ionized matter (the plasma). 'Magnetosphere' is the term used to describe the plasma surrounding the earth to several earth radii, and dominated by the earth's magnetic field. It is common to think of the greater part of the magnetosphere in static terms, as a relatively calm expanse of quiescent plasma. However, there is no reason for adopting such a view, and indeed convective motions of the ionization can be established without difficulty. Convection of the whole magnetosphere is in fact implicit in a variety of circumstances (for example, the tidal dynamo theory) in which driving forces are exerted on the ionization at relatively low levels. The complementary case of convection generated at extreme altitudes has not been paid much attention as yet, but its consequences may be important in many phenomena.

In an article contributed to the *Canadian Journal of Physics*, 1961, 39, 1433, Axford and Hines deal with the occurrence at high latitudes of a large number of geophysical phenomena, including geomagnetic agitation and bay disturbances,

auroræ, and various irregular distributions of ionospheric electrons. The authors show that these may all be related in a simple way to a single causal agency, namely, a certain convection system in the outer portion of the earth's magnetosphere. The source of this convection is taken to be a viscous-like interaction between the magnetosphere and an assumed solar wind which produces motion of the interplanetary gas in a direction outward from the sun. The strength and extent of this convection will naturally be dependent on the solar activity. The effect of this convection is that while the geomagnetic lines in the lower latitudes are of a roughly dipole shape, the high-latitude field lines are swept into the lee of the earth to form a geomagnetic 'tail'.

The proposed model is capable of accounting for many aspects of the phenomena concerned including the morphology of auroral forms and the occurrence of 'spiral' patterns in the location of maximum intensities of several features. It also bears directly on the steady state of the magnetosphere, and in particular on the production of trapped particles in the outer Van Allen belt.

## INDIAN ACADEMY OF SCIENCES: XXVII ANNUAL MEETING

**T**HE Twenty-Seventh Annual Meeting of the Indian Academy of Sciences was held at Mysore under the auspices of the University of Mysore, on the 26th, 27th and 28th December 1961. Prof. N. A. Nikam, Vice-Chancellor of the University, inaugurated the session at the Crawford Hall of the University before a large gathering of visitors, Fellows and Delegates.

Sir C. V. Raman, F.R.S., N.L., President of the Academy, delivered the Presidential Address on "The Alkali Halides". Recent developments in optical technology have enabled the alkali halides which are transparent solids crystallising in the cubic system to be prepared in the form of large transparent blocks. These can be cut and polished into the form of prisms and lenses and used as components for infra-red spectroscopy. They have thus come to play an exceedingly important role in the advance of scientific knowledge at the present time. Prof. Raman dealt in detail with his latest researches on the spectroscopic behaviour of rock-salt. These have led to the discovery that the absorption of infra-red radiation by rock-salt proceeds stepwise and that it is a consequence of successive orders of absorption in which an integral number of vibrational quanta or units of energy are taken up by the crystal and transformed into heat. The first-order absorption terminates at  $56\mu$ , the second order at  $28\mu$ , the third order at  $19\mu$  and the fourth order at  $14\mu$ . The successive orders of absorption decrease rapidly in strength and absorptions of orders higher than the fourth are too weak to be observable. It is these circumstances which determine the practical limit of wavelength for the use of rock-salt prisms for infra-red spectroscopy at  $15\mu$ .

A further discovery of Prof. Raman is that the spectrum of free vibrations of rock-salt structure is not continuous but consists of a set of nine discrete frequencies. These are the five cubic modes (involving coupled oscillations of the Na and Cl nuclei) given by  $180\text{ cm}^{-1}$  (Principal), 150, 129, 110 and  $92\text{ cm}^{-1}$ , and the four octahedral modes (in which only the Na or only the Cl nuclei oscillate) given by 170 (Na), 157 (Na), 140 (Cl) and  $117.5\text{ (Cl)}$ . The highest of these frequencies, namely,  $180\text{ cm}^{-1}$  ( $55.6\mu$ ), is that most powerfully active as an absorber of infra-red radiation. These frequencies can be calculated from dynamical theory and they are in agreement with the spectroscopically determined values. Finally,

Prof. Raman has shown that from these spectroscopically determined frequencies, the thermal energy content of the crystal can be theoretically evaluated as a function of the temperature from room temperature down to the absolute zero. The agreement found between theory and experiment proves the correctness of the approaches made alike to spectroscopic theory and to the theory of specific heats.

On the second day of the meeting, the forenoon session consisted of a symposium on "Optical Rotatory Power" in which eight participants took part. Dr. G. N. Ramachandran, Chairman, initiated the symposium by speaking on "Optical Rotation and Absolute Configuration". Dr. S. Chandrasekhar presented a paper on "Optical Rotatory Dispersion of Crystals". Dr. S. Pancharatnam dealt with "Optical Rotation in Crystals and the Effect of Absorption". Prof. T. R. Govindachari spoke on the "Application of Optical Rotatory Dispersion in the Field of Terpenoids". Prof. D. K. Banerjee spoke on "Octant Rule". Dr. M. V. Bhatt's paper was on "Detection and Implication of Ketol Formation". Dr. V. Sasisekharan gave an account of "Optical Rotatory Dispersion of Amino-acids", and Shri S. Venkateswaran explained the "Optical Rotation of the  $\alpha$ -Helix".

In the afternoon session there was a symposium on "X-rays and Crystals" in which three 40-minute talks were given, namely, Dr. G. N. Ramachandran on "Random Walk Problems in Crystallography"; Dr. S. Ramaseshan on "X-rays in Organic Chemistry" and Dr. S. Chandrasekhar on "Use of Polarized X-rays in the Analysis of Crystal Structure".

On the third day forenoon there were two invited talks, one by Dr. C. V. Subramanian on "Foot-Rot Disease in Wheat" and the other by Dr. T. V. Desikachari on "Diatoms".

Later Dr. D. Krishnamurti presented a paper on "The Raman Spectrum of Rutile" and Dr. T. R. Anantharaman gave a talk on "Studies in X-ray Line-Broadening in Metals".

The afternoon session on the third day was a discussion meeting.

There were two public lectures besides the symposia and scientific meetings. The first lecture was on the 27th evening by Dr. Vainu Bappu, Director, Astrophysical Observatory, Kodaikanal, on "The Sun". The second lecture was by Sir C. V. Raman on the evening of the 28th, on "Gems and Gemmology".

At the Business meeting on the 26th December 1961 the following were elected Fellows of the Academy. Dr. S. Chandrasekhar, Professor of Physics, Mysore University, Mysore; Dr. (Mrs.) V. Chinnaswami Anguli, Professor of Pathology, Stanley Medical College, Madras; Shri I. C. Chopra, Officer-in-Charge, Regional Research Laboratory, Jammu and Kashmir.

The following were elected as Honorary Fellows: Sir John Cockcroft, Master of Churchill College, Cambridge, England; Dr. Earle K. Plyler, National Bureau of Standards, Washington D.C., U.S.A.; Dr. Gyorgy Szigeti, Director of the Technical Physics Institute of the Hungarian Academy of Sciences, Budapest, Hungary.

## INDIAN SCIENCE CONGRESS — 49TH SESSION

**T**HE Forty-Ninth Session of the Indian Science Congress was held in Cuttack, Orissa, from the 3rd to the 9th January 1962. The session was inaugurated by Prime Minister Jawaharlal Nehru.

Dr. B. Mukerji, Director, Central Drug Research Institute, Lucknow, who was the General President of the Congress for the year delivered the Presidential Address on "Impact of Life Sciences on Man". The subject of Life Sciences has presently become a meeting ground of all sciences, physical and biological alike. Physical sciences and technology have not only provided precise tools of measurement and analysis but also have considerably changed the outlook of modern biologists. The basic approach in the study of life sciences is to analyze the component units of living systems, trace out the relation of form and function, and use this knowledge for a proper understanding not only of individual organs of the body but the intact living organism as a whole. Although modern researches have thrown much light on the working of individual parts of our body very little is known about the mechanism that co-ordinates all these activities and confers on us our human traits and personality. Life sciences have to be applied more intensively in the coming years to unravel these intricate and delicately balanced mechanisms. The eventual aim of life sciences should be to explore all the aspects of human life and activity both in the normal and abnormal phases and provide us with clues to a better knowledge of Man than we have presently.

More than 1,500 papers communicated to the Congress were presented at the meetings of the thirteen sections. The Sectional Presidents and the titles of their Presidential Addresses are as follows: (1) Dr. P. L. Bhatnagar (Mathematics), "Non-Newtonian Fluids"; (2) Dr. C. Chandrasekhar (Statistics); (3) Prof. Vikram A. Sarabhai (Physics), "Cosmic Rays and Interplanetary Space"; (4) Dr. R. P. Mitra (Chemistry), "Electrochemistry of Extended Structures"; (5) Dr. R. P. Rode (Geology), "Alpine Orogeny and Crustal Evolution"; (6) Prof. J. Venkateswarlu (Botany), "Pachytene Chromosomes"; (7) Dr. L. S. Ramaswami (Zoology), "Spawning Catfish and Frog with Hormones and Structure of Pituitary Gland"; (8) Dr. S. C. Sinha (Anthropology), "State Formation and the Rajput Myth in Tribal Central India"; (9) Dr. J. C. Banerjee (Medicine), "Coronary Heart Disease"; (10) Dr. P. K. Sen (Agriculture), "Scientists and Food Production"; (11) Dr. G. O. Esh (Physiology), "Nutritional Research"; (12) Dr. G. D. Boaz (Psychology), "Concept of Mind"; (13) Dr. V. Cadambe (Engineering).

On this occasion the Utkal University under whose auspices the Congress was held has brought out an illustrated *Souvenir*\* which presents a comprehensive picture of life in Orissa in all its aspects.

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\* *The Souvenir*, Edited by Dr. P. Parija and Shri S. C. Mukherjee, is also available in book form under the title "Orissa, Past and Present", priced at Rs. 10.

# STUDIES ON THE BRACONID, *AMYOSOMA ZEUZERÆ* ROHWER AN ECTOPARASITE OF THE COFFEE RED BORER, *ZEUZERA COFFEA* NIETNER

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SEVERAL parasites are recorded on the Red borer, *Zeuzera coffea* Nietner (Lepidoptera—Cossidae), a potential pest of Arabica coffee, *Coffea arabica* L.<sup>1,2,4-7</sup> Two of these, the entomogenous fungus, *Beauveria bassiana* Bals., and the braconid external parasite, *Amyosoma zeuzerae* Rohwer,—at least subspecifically different from *A. zeuzerae* Rohw. reported from Java<sup>3</sup>—have been found widely distributed in various coffee zones in South India. Field surveys at the Coffee Research Station, Balehonnur, have shown that a high percentage of host larvae is parasitized by the two aforesaid enemies; the latter contributing to at least 30% in March to May; the peak period of infestation.

In view of the obvious efficiency manifested by *A. zeuzerae* and of the apparent lack of information in the literature on its habits and life-history, studies were undertaken on these aspects at the Coffee Research Station. Host and parasite materials were collected in the field, and in the laboratory, observations were carried out by confining them in glass jars and glass chimneys of suitable sizes. The adult parasites were fed on a mixture of diluted honey and sugar solution. Temperature and relative humidity were recorded with a thermohygrograph during the study.

## HABITS

It was seen that all instars of the host larvae were parasitized, though the later instars sustained more parasites than the earlier ones. Parasitism was found confined on larvae in the primary and in the small branches of host plants than on those in the main stem. The locus of oviposition varied from the first thoracic to ninth abdominal segments of the host. Eggs were deposited mostly dorsad of the host, either singly or in groups of two to six. The maximum number of eggs found on a host larva was eight.

## LIFE-HISTORY

Freshly laid egg was glistening white in colour, mildly curved dorsoventrally, with the cephalic region slightly broader and more rounded than the caudal end. It measured about 1.0 mm. long by 0.25 mm. broad. During the latter part of incubation period, which lasted for 24-36 hours, the movements of the emerging larva were clearly visible through the chorion.

Ecdysis took place through the cephalic end of the egg.

There were four larval instars. Freshly emerged larva was pale white in colour and was about the same size as the egg. The head was triangular with the almost cylindrical antennae placed anterodorsally. The thoracic and the ten abdominal segments bore prominent setae dorsally and dorsolaterally. Spiracles were absent. After active roving on the host body for some time, the larva selected the intersegmental folds as the loci of attachment. Through the wound created by the sharp mandibles the body contents of the host were sucked in rhythmically. As feeding continued, the larva became more opalescent and, when full grown, it measured 0.7 mm. to 0.75 mm. in length. The instar averaged 30 hours in duration.

Body segmentation in the second instar larva was not as distinct as in the first and the prominent setae of the latter were found replaced by evenly distributed small setae. The head and the antennae were not as prominent as in the first instar and the former appeared retractile into the prothorax. In contrast to the first instar, spiracles were present in the prothoracic and first eight abdominal segments. They had a circular peritreme and a shallow, triangular non-reticulated atrium leading to an annulated stalk provided with a thick-walled closing apparatus. There were no apparent differences in the structure of spiracles on various segments. Feeding was almost continuous with interruptions for changing the site of attachment. The engorged food contents appeared as a coralline streak along the length of the body. The mesenteron was a blind sac and did not communicate to the exterior through the hind gut. The average length of the larva just before moult was 1.5 mm. The instar lasted for about 24 hours.

The third instar larva possessed a prominent tracheal system, well contrasted against the dark body contents. With continued feeding and consequent increase in size, white discoid bodies appeared in the body dorsally. When engorged, the larva averaged 2.5 mm. in length. The instar ranged from 36 to 48 hours in duration.

The fourth instar larva, in general, appeared similar to the third except for the body size and proportion of the head. The latter was protruded

and appeared not so retractile as in the earlier instars. Increase in size was noticeable especially on abdominal segments four to eight. The white discoid bodies were found in groups and coralline body contents were localized posteriorly in abdominal segments three to eight. When full grown it measured 2.9 mm. in length. As feeding stopped, the larva prepared for pupation and an average duration of 24 hours intervened between abandoning of the host body and commencement of spinning cocoon. The latter process, also lasting for 24 hours, consisted of three phases; the first in which the foundation strands were attached to the surface by extending them over the larva; and the second and third phases when further strands were laid to make a closely woven matrix. On completing 5 days in the fourth instar, the larva entered the prepupal stage, the latter averaging 48 hours in duration.

The cocoon was papyraceous, shining white in colour, measured 8.0 mm.  $\times$  2.0 mm. and often occurred in moist locations in groups of three to five enveloped in a common web. The maximum distance observed between these and the host remains was 12.75 cm. In the field, cocoons within the secondary and tertiary branches were located towards their proximal ends.

The mesenteron which was a blind sac till the last larval instar established connection with the hind gut during the prepupal stage and this was followed by the extrusion of meconium as brownish black droplets.

The exarate pupa, to begin with, appeared shining white in colour. Eyes and ocelli progressively became pigmented. At the end of five days, the head became completely black and nitidous. The prothorax was black dorsally, while the meso- and metathorax less so. A dusky linear pattern developed on the median dorsal region of first abdominal segment while the rest of the abdomen was yellow to light brown. By the seventh day, head, thorax and appendages were completely black and further pigmentation took place on the abdominal segments. Mild movements were discernible by the ninth day and emergence of the imago took place on the eleventh day through an irregular hole at the cephalic region of the cocoon. Emergence occurred only during daytime. It was also observed that all adults, irrespective of the size and number of cocoons in a group, emerged

within two hours while, those from cocoons kept singly, and isolated from each other, took longer periods for the process. Thus, it appeared that in a group of cocoons, the mechanical stimulus transmitted by one imago, in the process of emergence, induced the quick succession of other emergents.

The adults were highly phototropic and their longevity averaged five and six days for male and female respectively. Table I gives the duration of stages in relation to temperature and relative humidity.

Parasitized hosts appeared paralysed and became progressively pale and flaccid. Body wall bore yellow areas in patches suggesting the loci of attack of the parasite larvæ. Ultimately, only the flexible cuticle of the host body remained; the parasite larvæ having consumed the entire body contents.

TABLE I  
Life-history of *A. zeuzeræ*

Stage	No. of cases	Duration in hours/days	Average		
			Max. Temp. °C.	Min. Temp. °C.	R.H.
Egg	.. 12	24-36 hrs.	27.8	24.4	46-87
I instar larva	.. 12	30 hrs.	28.9	24.4	51-75
II "	.. 12	24 hrs.	27.8	25.6	60-75
III "	.. 12	36-48 hrs.	27.2	24.7	55-00
IV "	.. 12	5 days	27.5	24.7	57-84
Prepupa	.. 22	48 hrs.	27.2	25.5	64-92
Pupa	.. 22	11 days	26.6	24.2	69-20
Adult	.. ♀ 15	6 days	27.3	25.3	68-58
	.. ♂ 10	5 days	27.3	25.7	69-95

The author is grateful to Dr. P. S. Sekhar, Entomologist, for guidance and help in preparation of this paper and to Dr. N. G. Chokkanna, Director of Research, for evincing keen interest in the study. He is also indebted to the staff of the Division of Entomology for help in collection of host and parasite material.

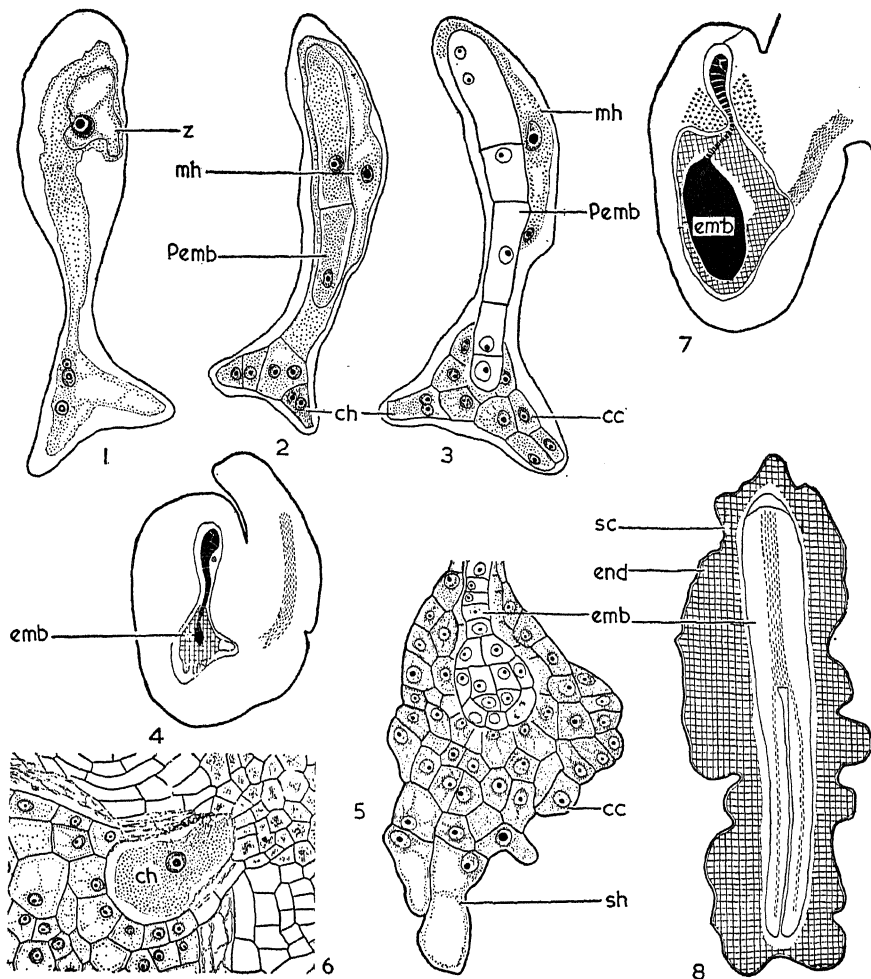
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# ENDOSPERM AND SEED DEVELOPMENT IN *ANDROGRAPHIS ECHIOIDES* NEES

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SINCE the publication of Mauritzon,<sup>1</sup> several papers have appeared on the embryology of the family Acanthaceæ. Besides the curved body of the endosperm with haustoria at both

ends, the seed structure is of considerable morphological interest in this family. Taxonomists state that the seed is exalbuminous in all the members of the Acanthaceæ excepting those



FIGS. 1-8. Fig. 1. Embryo-sac showing the zygote and fusion of one male cell with a polar nucleus,  $\times 314$ . Fig. 2. An early stage of endosperm showing the central endosperm chamber, a 2-nucleate chalazal haustorium and the elongated micropylar haustorium enclosing a 2-celled proembryo,  $\times 314$ . Fig. 3. A later stage in endosperm development. Note the filamentous proembryo,  $\times 314$ . Fig. 4. L.s. ovule at the globular proembryo stage,  $\times 53$ . Fig. 5. Part of endosperm enlarged from Fig. 4 to show the cellular endosperm with prominent secondary haustoria,  $\times 314$ . Fig. 6. Part of the seed showing the chalazal haustorium, cellular endosperm,  $\times 314$ . Fig. 7. L.s. ovule at the late torpedo stage of embryo,  $\times 53$ . Fig. 8. L.s. seed with dicotyledonous embryo embedded in the persistent ruminant endosperm. Note that the seed is practically naked,  $\times 31$ .

(cc, central endosperm chamber; ch, chalazal haustorium; emb, embryo; end, endosperm; mh, micropylar haustorium; pemb, proembryo; sc, seedcoat; sh, secondary haustoria; z, zygote.)

belonging to the subfamily Nelsonioideæ. However, Mohan Ram<sup>2</sup> showed the presence of a persistent and ruminate endosperm in the mature seeds of *Andrographis serpyllifolia*, a member of the tribe Andrographideæ of the subfamily Acanthoideæ.

The present study was undertaken to investigate if *Andrographis echinoides*, a local weed, exhibits embryological features similar to those observed in *A. serpyllifolia*.

The organised embryo sac has a fish-like outline with a somewhat swollen micropylar end and a bifurcated chalazal part. The synergids and the antipodal cells are both ephemeral and degenerate soon after fertilization. During triple fusion the male gamete joins one of the polar nuclei before the other polar nucleus enters into the fusion (Fig. 1).

The earliest stage of the endosperm observed by us shows three chambers, viz., micropylar, central and chalazal (Fig. 2). The micropylar and the chalazal chambers form the haustoria. The micropylar haustorium is large and has two prominent nuclei. It harbours within it the hypertrophied embryonic suspensor during the later stages of seed development. The chalazal haustorium is a small, 2-nucleate structure lying adjacent to the hypostase (Fig. 4).

Divisions in the central endosperm chamber are followed by the laying down of walls (Fig. 3). After a sufficient number of cells have been produced, some of the peripheral cells of the endosperm proper that lie away from the two haustoria elongate and penetrate into the neighbouring integumentary cells (Figs. 4, 5). These uninucleate outgrowths have been designated as secondary haustoria (Fig. 5). They degenerate prior to the differentiation of the cotyledons.

The developing embryo consumes the surrounding endosperm while the latter uses up

the enveloping integument (Fig. 7). At certain points the endosperm consumes more of the integumentary tissues than at others. This unequal activity results in a ruminated condition of the endosperm (Fig. 8).

Embryo development is similar to that in *A. serpyllifolia*. The suspensor cells are multinucleate, hypertrophied and richly cytoplasmic. The mature embryo is elongated and embedded in the persistent endosperm (Fig. 8). The integument is massive to begin with, but gradually it becomes thinner due to the activity of the encroaching endosperm. The mature seed is almost devoid of a seedcoat.

*A. echinoides* and *A. serpyllifolia* share several embryological features though there is a remarkable difference in their habit and distribution.

Both the species have fish-shaped embryo-sacs and a Cellular endosperm with coenocytic micropylar and chalazal haustoria. The occurrence of secondary haustoria and the absence of a basal apparatus are additional features common to both. The endosperm is persistent and ruminate—a feature uncommon in the subfamilies Acanthoideæ, Thunbergioideæ and Mendoncioideæ but reported only in the subfamily Nelsonioideæ (Johri and Singh,<sup>3</sup> also authors' unpublished observations on *Nelsonia campestris*). The large coenocytic suspensor cells of *A. echinoides* and *A. serpyllifolia* have so far not been recorded in the Acanthaceæ and are perhaps peculiar to the genus *Andrographis*.

Grateful thanks are extended to Professor P. Maheshwari for his comments.

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## SEMICONDUCTING DIAMONDS

**M**ETHODS have been discovered at the General Electric Research Laboratory which make it possible for the first time to produce semiconducting diamonds. Such diamonds are extremely rare in nature, accounting for less than 1% of natural diamonds.

Diamonds are made semiconducting by adding impurities such as boron, beryllium or aluminium to the mixture of graphite and catalyst from which diamonds are made. The mixture is subjected to pressures of about 1 million pounds per square inch and temperatures above 2000 F. Under these conditions, diamonds form with concentrations of 1% or less of the desired

impurity, and have electrical conductivities in the semiconducting range.

The semiconducting diamonds prepared with boron are blue in shades ranging from a pale blue-white to a deep blue-black depending on how much boron is present in the crystal. Semiconducting diamonds found in nature, which have been studied for many years by a number of investigators, are also sometimes blue. One of the most famous blue-white diamonds is the Hope diamond, and although its conductivity has not been measured, its colour suggests that it is probably a semiconductor.—(*Jour. Frank. Inst.*, 1961, 272, 424.)

# LETTERS TO THE EDITOR

## ULTRASONIC STUDIES IN AQUEOUS SOLUTIONS OF URANYL NITRATE

It is known that electrolytes in general exhibit increase of ultrasonic velocity with concentration. However, deviations from this type of behaviour have been reported by some.<sup>1-5</sup> In the course of our studies we found that uranyl nitrate showed a decrease of ultrasonic velocity with increasing concentration. All other properties like adiabatic compressibility, molar sound velocity varied regularly.

In the present investigation the double-crystal, fixed-path, variable frequency interferometer<sup>6</sup> was used for the measurement of ultrasonic velocity. The sample used is of B.D.H., Analar quality. All measurements were carried out at a temperature of 32° C. The accuracy of the interferometer is 1 metre/sec. Adiabatic compressibility and apparent molal compressibility were calculated by the usual formulæ. The molar sound velocity  $R$ , and molar compressibility,  $B$ , were calculated using the relations,

$$R = \frac{M}{\rho} V^{1/3} \quad \text{and} \quad B = \frac{M}{\rho} \beta^{-1/2}$$

$M$  is the average molecular weight of the solution given by  $(n_1 M_1 + n_2 M_2) / (n_1 + n_2)$

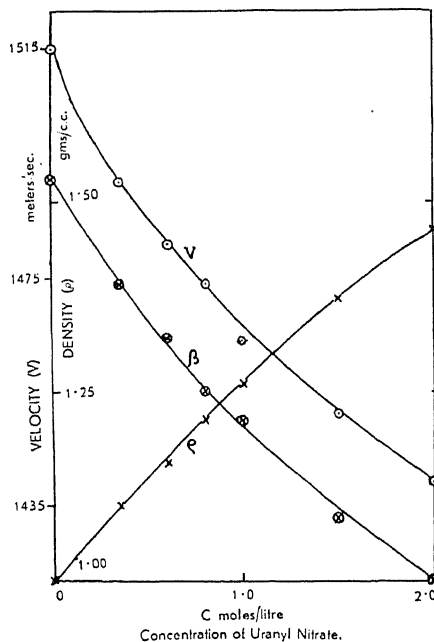
where,  $n_1$  and  $M_1$  and  $n_2$  and  $M_2$  are respectively the number of moles and molecular weights of the solute and the solvent. The molar concentration was calculated using the relation  $C_m = n_1 / n_1 + n_2$ . The results are presented in Table I.

TABLE I

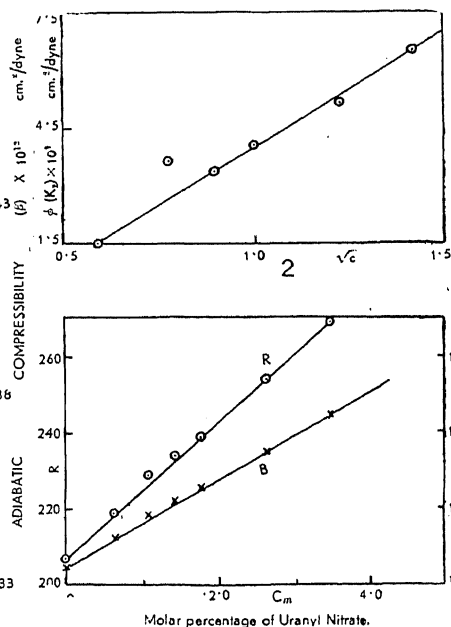
Uranyl nitrate

[ $UO_2(NO_3)_2 \cdot 6H_2O$ ]. Mol. wt. 502.18,  $T = 32^\circ C$ .

C Conc. Moles/litre	V Velocity Metres/sec.	$\rho$ Density gm./ml.	$\beta_{ad} \times 10^{12}$ cm. <sup>2</sup> /dyne	$\phi$ ( $K_2$ ) $\times 10^{12}$	R	B	$C_m$ % Molar Conc.
0	1515	1.000	43.57	..	206.9	10.51	0
0.35	1492	1.100	40.83	1500	218.7	11.27	0.627
0.60	1481	1.157	39.41	3553	228.5	11.86	1.070
0.80	1474	1.212	37.97	3333	233.8	12.22	1.421
1.00	1459	1.263	37.18	4030	238.8	12.56	1.770
1.50	1451	1.371	34.64	5153	253.9	13.52	2.632
2.00	1439	1.462	33.04	6552	268.9	14.45	3.478



1



3



Figure 1 shows the variations of ultrasonic velocity, adiabatic compressibility, and density with the concentration of the electrolyte expressed as moles/l. Figure 2 shows the plot of the apparent molal compressibility  $\phi(K_2)$ , against the square-root of concentration ( $\sqrt{c}$ ), which is linear. Figure 3 shows the variations of R and B with molar concentration ( $C_m$ ) of the electrolyte, which are also linear. Figure 1 shows that the ultrasonic velocity decreases with increase of concentration (76 metres/sec. for a concentration of 2 moles/l.), whereas, the density is steadily increasing and the compressibility is steadily decreasing. The slope of the curve, apparent molal compressibility vs. square-root of concentration, i.e.,  $\delta\phi(K_2)/\delta\sqrt{c}$ , should be  $32.6 \times 10^{10}$  c.g.s. units as calculated from Gucker's limiting equation, as uranyl nitrate is a (2-1) type of electrolyte. The experimental slope is, however,  $55 \times 10^{10}$  c.g.s. units which is far from the theoretical value. The decrease of velocity in uranyl nitrate is in conformity with the observations of previous workers,<sup>3</sup> namely that electrolytes with heavy acid or metallic radicals produce decrease in velocity with increasing concentration.

Ultrasonic Laboratories, M. G. SESHAGIRI RAO.  
Andhra University, B. RAMACHANDRA RAO.  
Waltair, November 18, 1961.

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#### PAPER CHROMATOGRAPHIC METHOD FOR THE SEPARATION OF CADMIUM AND ZINC FROM ONE ANOTHER AND THEIR DETECTION

In a previous communication it has been shown that several metal ions separate out as distinct spots on paper using thiocyanate as complexing agent and *n*-amyl or butyl alcohol-pyridine-ammonia as the eluent.<sup>1</sup> It is of interest to note that the pyridine thiocyanates of these ions are soluble in organic solvents.<sup>2</sup>

A study of the solubility of metal thiocyanates indicates that whereas zinc thiocyanate is soluble in organic liquids, cadmium thiocyanate is not. On the other hand the pyridine thiocyanates of both of these ions are soluble in organic liquids, particularly chloroform.<sup>3</sup>

Zinc and cadmium occur together in a number of combinations. The presence of cadmium in zinc casting is considered deleterious.<sup>4</sup> In food processing where zinc plating has to be used, the presence of cadmium can lead to

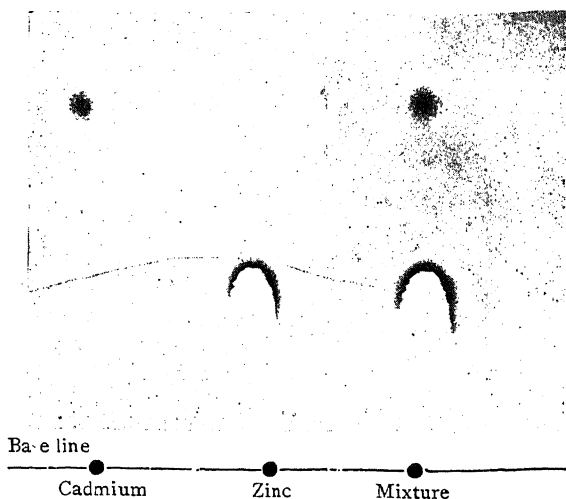


FIG. 1

poisoning.<sup>5</sup> Methods have, therefore, been developed for detecting cadmium in the presence of zinc. In the present investigations, a chromatographic method has been developed for the separation and detection of cadmium and zinc when present together.

#### EXPERIMENTAL

Following solutions were prepared :

1. Zinc sulphate M/50.
2. Cadmium sulphate M/50.
3. Potassium thiocyanate 44%.
4. Cobalt mercuric thiocyanate—Equal volumes of cobalt sulphate (0.02% in 5 N HCl) and alkali mercury thiocyanate (8 gm. of mercury chloride and 9 gm. of ammonium thiocyanate in 100 ml. of water) were mixed.
5. Hydrogen sulphide.
6. *n*-Butanol.
7. Pyridine.
8. *n*-Amyl alcohol.
9. Ammonia.

One drop each of zinc and cadmium solution was applied separately about 1.5 inch apart on the base line of Whatman filter-paper No. 1. One drop of potassium thiocyanate solution was applied on the spots. The paper was rolled in the form of a cylinder and kept inside a trough containing (i) *n*-Butanol-ammonia-pyridine (80 : 10 : 20) ; (ii) *n*-Amyl alcohol-ammonia-

pyridine (80 : 10 : 20) as the eluent and immediately covered with a bell-jar. The paper was allowed to develop till the liquid front reached near the top. It took nearly five hours. The paper was taken out and the spots detected by the following methods.

The vertical portion of the paper, which was expected to contain cadmium, was blocked with two or three folds of filter-paper. The strip which was expected to contain zinc was sprayed with cobalt mercuric thiocyanate when a blue crescent indicating the position of zinc was visible.

The zinc spot was now blocked with paper and the strip containing cadmium was exposed to hydrogen sulphide when a yellow spot appeared.

The Rf values of zinc and cadmium spots were respectively 0.29 and 0.51.

In the above cases, if the two positions are not effectively blocked in the respective operations of testing for zinc by mercury thiocyanate or of cadmium by hydrogen sulphide, there is a difficulty in the location of the position of the ions.

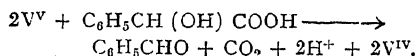
In a separate case, drops of zinc cadmium solutions and of mixture of the two were applied separately some distance apart on the base line of the filter-paper and the spots developed in the usual manner. The positions of zinc and cadmium spots individually were located by the above methods and then the resolved spots from their mixture were detected after careful blocking, viz., of cadmium during the testing of zinc and *vice versa*. In the accompanying figure is shown a typical chromatogram showing the separation of cadmium and zinc. The method of resolution and detection can be worked over a fairly wide range of ratios of the concentration of two ions in a mixture.

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November 28, 1961.

## KINETICS OF THE OXIDATION OF MANDELIC ACID BY QUINQUEVALENT VANADIUM

A REVIEW of the existing literature reveals that very little attention has been paid to the kinetics of the oxidation of  $\alpha$ -hydroxy-acid by quinquevalent vanadium. Recently Waters and his co-workers<sup>1</sup> have studied the mechanism of the oxidation of Pinacol, Ketones (Cyclohexanone and Cyclopentanone), Cyclohexanol, some  $\alpha$ -Glycols and Alcohols and made a general survey of the oxidation of organic compounds by vanadium (V) qualitatively.<sup>1a</sup> The oxidation of mandelic acid has, therefore, been undertaken to elucidate the manner in which vanadium (V) oxidises this substance.

Mandelic acid has been found to be oxidised to Benzaldehyde and can be represented as :



(Found : 1.9 equivalent of  $V^V$  per mole of mandelic acid.) A weighed sample of mandelic acid was oxidised overnight by a known excess of vanadium (V) solution (for stoichiometry also) and after reduction of excess of vanadium (V), 2, 4-dinitrophenylhydrazine was added to the solution and Benzaldehyde, 2, 4-dinitrophenylhydrazone (after recrystallisation), m.p. 236° C. was collected in 98% yield.

Kinetic study of the oxidation has been made by the use of Morette and Gaudefroy's method,<sup>2</sup> which in daylight proved to be more rapid and reliable at low concentrations than electrometric titrations. Sodium-metavanadate (A.R.) in aqueous sulphuric acid solution was used as oxidiser and by the method of independent variation of both mandelic acid and vanadium (V), the reaction has been found to be first order in vanadium (V), up to 80% completion and also of the first order in mandelic acid as has been shown by Tables I and II. The reaction was carried out in a thermostat which maintained temperature constant to  $\pm 0.1^\circ$  C.

The first-order dependence of velocity constants on  $[H^+]$  can be seen from the slope of the plot of  $\log k_1$  (log of second order rate constant in litres mole<sup>-1</sup> sec.<sup>-1</sup>) against  $\log [H^+]$  (Fig. 1). The slope of the straight line curve comes out to be 0.9 between 0.7 N and 1.07 N sulphuric acid. Waters *et al.*,<sup>1a</sup> however, have found the reaction between pinacol and vanadium (V) in this range of acidity to be acid-independent, whereas West and Skoog<sup>3</sup> have found a second-order dependence for Glycerol-Vanadium (V) reaction and consider  $VO^{+3}$  as an active oxidant. At lower concentration of the

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TABLE I

Dependence of rate on vanadium (V) at 33° C.

[H<sub>2</sub>SO<sub>4</sub>] = 1.0 N; [Mandelic Acid] = 0.09 M

Initial V <sup>V</sup> (Moles)	$k_1 \times 10^3$ (sec. <sup>-1</sup> )
0.0186	2.83
0.0155	2.96
0.0124	3.01
0.0093	2.92

TABLE II

Dependence of rate on mandelic acid at 32° C.

[H<sub>2</sub>SO<sub>4</sub>] = 0.136 N; [Initial V<sup>V</sup>] = 0.01 N

[Mandelic acid]	$k_1 \times 10^3$ (sec. <sup>-1</sup> )	$k_1$ /[Acid]
0.045	4.37	0.097
0.036	3.36	0.091
0.027	2.74	0.101
0.018	1.86	0.103
0.009	0.903	0.100

TABLE III

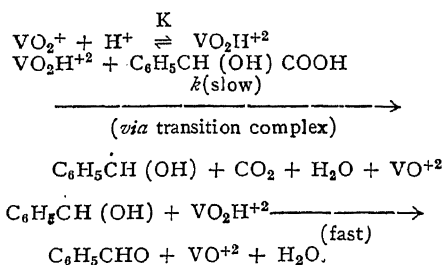
Dependence of rate ionic strength

[H <sup>+</sup> ] = 0.157 N* (A) Temp. = 32 ± 0.1° C.		[H <sup>+</sup> ] = 0.136 N† (B) Temp. = 33 ± 0.1° C.	
$\mu$	$k_1 \times 10^2$ (litres mole. <sup>-1</sup> sec. <sup>-1</sup> )	$\mu$	$k_1 \times 10^2$ (litres mole. <sup>-1</sup> sec. <sup>-1</sup> )
0.497	3.185	0.428	3.277
0.512	3.213	0.458	3.240
0.530	3.150	0.498	3.264
0.557	3.206	0.558	3.270
0.630	3.217	0.628	3.281

\*(A) Addition of potassium sulphate.

†(B) Addition of sodium chloride.

reactants, no primary salt effect has been observed by the addition of potassium sulphate and sodium chloride (Table III). This indicates that the reaction is between a molecule and an ion (cf. Waters<sup>1a</sup>). It has been found that free radicals are formed during the oxidation of  $\alpha$ -hydroxy-acids by acid permanganate,<sup>4</sup> manganic pyrophosphate<sup>5</sup> and vanadium (V),<sup>1a</sup> which induce polymerisation in vinyl cyanide and reduce mercuric chloride. A slight, but definite turbidity, has, however, been obtained when mercuric chloride test is applied. The results seem to accord with the following mechanism:



Alternatively,  $\text{V}(\text{OH})_3^{+2}$  formed according to the equilibrium:  $\text{VO}_2^+ + \text{H}_3\text{O}^+ \rightleftharpoons \text{V}(\text{OH})_3^{+2}$ , or a sulphate complex of vanadium (V), can also be responsible for oxidation. The work

is in progress to further elucidate the reaction mechanism from the study of energy and entropy

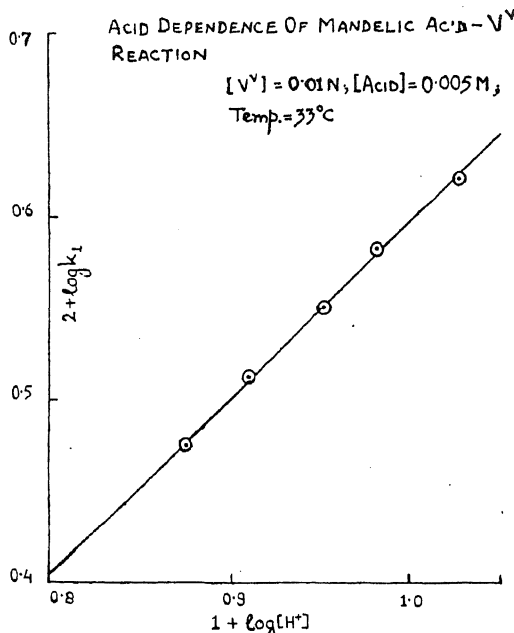


FIG. 1

of activation in aqueous sulphuric acid and perchloric acid solutions. The investigation is being extended to other hydroxy-acids.

Department of Chemistry, RAMA SHANKER.  
Dungar College, Bikaner, S. N. SWAMI.  
September 14, 1961.

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#### CHALKONES DERIVED FROM 4-CHLORO-QUINACETOPHENONE AND ITS METHYL ETHERS

IN extension of the work on chalkones and related compounds derived from quinacetophenone,<sup>1-4</sup> work on 4-halogenated-quinacetophenone was undertaken.

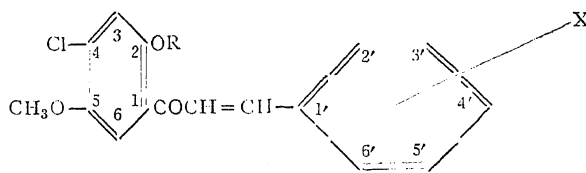
4-Chloro-quinacetophenone was prepared by the Fries rearrangement of 2-chloro-quinoldiacetate.<sup>5</sup> It was selectively methylated according to Shah and Vyas,<sup>6</sup> to get mono and dimethyl ethers.

The condensation of 4-chloro-quinacetophenone with benzaldehyde in presence of alkali as well as phosphorus oxychloride takes an

abnormal course and the products obtained are under investigation. The condensation of its mono and dimethyl ethers with various aldehydes was effected using (a) 40% alkali, (b) phosphorus oxychloride and (c) dry hydrogen chloride in presence of dry ethylacetate as solvent, when the corresponding Chalkones were obtained. Optimum yields are obtained using 40% alkali as condensing agent. The methylation of Chalkones derived from monomethyl ether gave the chalkones identical with the chalkones derived from dimethyl ether, mixed melting points being undepressed.

The details regarding the chalkones are given in Table I.

TABLE I. General formula for Chalkones:



No.	R=	Substituent of 'X'	Melting points (°C.)	Solvent	Shape and colour of crystals	Analysis of 'Cl' %	
						Theo.	Obtd.
1	H	H	122-23	Ethanol	Orange yellow needles	12.30	12.15
2	H	4'-dimethylamino	129-30	do.	do.	10.71	10.64
3	H	2'-3' phenyl	126-27	do.	Orange needles	10.49	10.32
4	H	4'-chloro	165-66	do.	Yellow particles	21.98	21.90
5	H	2'-4'-dichloro	156-57	Petrol ether	Red plates	29.81	29.67
6	H	3'-4'-methylene-dioxy	164-65	Acetic acid	Golden yellow needles	10.63	10.59
7	H	4'-methoxy	142-44	Ethanol	Yellow granules	11.15	11.07
8	CH <sub>3</sub>	H	105-06	do.	Greenish yellow needles	11.73	11.65
9	CH <sub>3</sub>	4'-chloro	141-42	do.	Yellow woolly needles	21.08	20.93
10	CH <sub>3</sub>	3'-4'-methylene-dioxy	147-48	do.	do.	10.30	10.20
11	CH <sub>3</sub>	2'-4'-di-chloro	171-72	do.	Yellow needles	28.66	28.51
12	CH <sub>3</sub>	4'-di-methyl-amino	140-41	do.	do.	10.28	10.11
13	CH <sub>3</sub>	2'-hydroxy	171-72	do.	do.	11.15	10.96
14	CH <sub>3</sub>	4'-methoxy	119-20	do.	do.	10.68	10.56
15	CH <sub>3</sub>	2'-3'-phenyl	138-39	do.	do.	10.08	10.01

To a cold solution of aldehyde (1 mol.) and 4-chloro-quinacetophenone-mono-methyl-ether (1 mol.) in ethanol (50 ml.) was added potassium hydroxide (20 ml.—40%) and the reaction mixture was then left at room temperature for 24 hours. It was then treated with ice and acidified with cold hydrochloric acid (1:1). The solid obtained was collected and crystallised from a suitable solvent.

The condensation of 4-chloro-quinacetophenone-dimethyl-ether with various aldehydes as above gave the chalkones instantaneously, which were collected and crystallised from ethanol, except in case of salicyl-aldehyde which takes seven days for completion of the reaction. The yields of these chalkones were favoured if the reaction mixture was kept at room temperature for about 4 hours and then worked up as usual.

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### ISOLATION OF MUCIC ACID FROM THE FRUITS OF *EMBLICA OFFICINALIS*, GAERTN.

TILL recently, mucic acid (D-galactaric acid) was considered as not occurring in natural products. It has been detected in putrefied blood,<sup>1</sup> in the diffusion juice of sugar beet,<sup>2</sup> in some marine algae<sup>3</sup> and in grape-vine shoots (1.63%?).<sup>4</sup> It has been isolated from the fruits of *Eleocarpus serratus* L. (Ceylon olive, 0.5%)<sup>5</sup> and from ripe peaches and pears (0.005%).<sup>6</sup> Many derivatives of mucic acid have been prepared in absolute purity and their correct physical characteristics studied only recently.<sup>7-9</sup>

By far the largest yield of mucic acid in nature is found in the dried ripe fruits of *Embllica officinalis*, Gaertn. (Amla); bazaar samples yield between 4-9% of free (and combined?) mucic

acid. The latter is continuously deposited up to two months from cold aqueous extracts of the fruits kept under toluene. Tannin lead acetate precipitates when worked up give mucic acid in lesser yield. The best method for its isolation is by extracting the pulp of the pericarp with caustic soda to pH 8 and subsequent acidification of the alkaline filtrate.

Dimethyl mucate (m.p. 193-94° C.) has been isolated from the fruits by soxhleting the dry powdered pericarp with absolute methanol continuously for several days.<sup>10</sup> But it has now been found that esterification occurred during the extraction, probably catalysed by the plant acids present. This has been borne out by the fact that dimethyl mucate is completely hydrolysed by boiling with water for 4 hours, the distillate containing the calculated amount of methanol (colorimetric estimation,<sup>11</sup>) whereas the distillate obtained by boiling the powdered pericarp itself with water contains only very negligible amount of methanol. Soxhleting the powdered pericarp with absolute ethanol gave diethyl mucate (1.1%, m.p. 166-67° C.).

Phyllemblic acid and emblicol, reported earlier,<sup>10</sup> were found to be mucic acid and dimethyl mucate, respectively, and the two names can be taken off from literature.

#### ISOLATION OF MUCIC ACID

(i) The dried powdered pericarp (1.0 kg.) was extracted with small quantities of distilled water and the extract squeezed out gave 1.4 litres of dark brown extract (pH 2.9). The clear centrifuged extract was kept under toluene for two weeks. The brownish white deposits (9.6 gm.), purified through crystallisation of the ammonium salt from water and subsequent acidification gave pure acid (5.4 gm.), m.p. 213-14° C. (dec.), and was identified as mucic acid by mixed m.p. and I.R. Spectrum.

The lead acetate precipitates from the above aqueous filtrate gave on working up 2.2 gm. of crude mucic acid.

(ii) The residual marc after the aqueous extraction was treated with sodium hydroxide (5%, 1.3 litres) to pH 8, filtered through linen, repeated with water (500, 250, 250 ml.), centrifuged and the alkaline extract (2.21 litres) was acidified with 20% HCl and kept for 48 hours at room temperature. The white powder (57.5 gm.), m.p. 208-10° C. (dec.), by purification as in (i) gave 33.2 gm. of pure mucic acid.

Anal.—Found: C, 34.65; H, 4.87;  $C_6H_{10}O_8$  requires C, 34.3; H, 4.79%.

Confirmation as to identity with mucic acid was given by preparing pyromucic acid (pyro-

lysis) and dimethyl and diethyl esters which were compared with the same products from mucic acid obtained by oxidation of galactose.

#### HYDROLYSIS OF DIMETHYL MUCATE

0.114 gm. of dimethyl mucate, obtained by methanol extraction of Amla, on distilling with water, gave 0.015 gm. of methanol in the distillate in 90 mins. (0.030 gm., nearly 100% hydrolysis in 4 hours). Even 100 gm. of dried powdered pericarp of the fruit when distilled with water for 90 mins. gave only 0.007 gm. of methanol (0.019 gm. in 4 hours). This can be given by even 0.055 gm. of the diester, whereas methanolic extraction yields 2.7% of pure diester, which therefore was produced by esterification during the long soxhleting.

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#### VOLUMETRIC DETERMINATION OF CADMIUM AS FERROCYANIDE

A REVIEW of the literature on the formation of cadmium ferrocyanide complexes revealed the dependence of their composition on the concentration of cadmium and ferrocyanide ions, the pH of the medium as also the interfering and/or stabilizing influence of other electrolytes.<sup>1</sup> Potentiometric titrations by Tananaev<sup>2</sup> and others however showed that in presence of KCl

the formation of  $K_2Cd[Fe(CN)_6]$  is more pronounced. During studies<sup>3</sup> on metal ferrocyanides it was observed that the addition of excess ferrocyanide to cadmium solution and the back titration of the excess with ceric sulphate indicated the formation of  $K_2Cd[Fe(CN)_6]$ . The present communication describes a direct titration of cadmium against ferrocyanide with diphenyl carbazone as an indicator.

Potassium ferrocyanide does not produce any characteristic colour on the addition of diphenyl carbazone, other than the brown colour of its alcoholic solution. However, the indicator develops a purple colour with cadmium ions. This suggested the feasibility of its use in the complexometric titration of cadmium. Trial experiments showed that during the course of the titration, when all the ferrocyanide has reacted with cadmium, the excess drop of cadmium produces an intense purple (cherry red) colour signifying the end-point of the precipitation reaction. This, as also the fact that no other indicator has been successfully used for the titrimetric determination of cadmium, led to a detailed investigation of this volumetric procedure.

Standard solution of cadmium sulphate was prepared by dissolving the accurately weighed quantities of a B.D.H. reagent grade pure sample in appropriate volume of water, the cadmium content was checked by oxine method. Recrystallised anhydrous potassium ferrocyanide was used and the solution was standardised with ceric sulphate.

To an aliquot of potassium ferrocyanide about 5-10 drops of saturated alcoholic solution of diphenyl carbazone are added along with an equal volume of 0.1 N KCl and the brown solution is titrated with cadmium sulphate. With the formation of the precipitate of cadmium ferrocyanide, the brown colour of the solution fades gradually and the end-point is characterised by a sudden change to purple colour. The end-point is sharp and if overrun, the titration may be continued by the addition of a further quantity of ferrocyanide. The reverse titration is also possible but the colour change from purple to colourless is not sharp. The molar ratio of  $Cd^{+2} : Fe(CN)_6^{4-}$  calculated from the quantity of cadmium reacting with ferrocyanide at the end-point was found to be 1 : 1. This was in agreement with the potentiometric titration data<sup>2</sup> that the composition of the precipitate corresponds to  $K_2Cd[Fe(CN)_6]$ . The addition of KCl is necessary but its overall concentration up to 0.2 N has no adverse effect on the end-point.

Using 0.1 N solution of ferrocyanide the accuracy and reproducibility of the results has been ascertained over a concentration range 40-300 mg. of cadmium. Compared with other methods of cadmium determination, the above procedure is equally dependable but less time-consuming and therefore easily applicable to routine analysis.

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#### MAGNETISM AND MOLECULAR STRUCTURE: STUDY OF MONOSUBSTITUTED BENZOIC ACIDS AND THEIR ESTERS

In recent years a number of papers have been published on the susceptibilities of organic isomeric compounds particularly the position isomers. In this investigation the authors have examined magnetic susceptibilities of monosubstituted benzoic acids and their methyl and ethyl esters with a view to find the effect of the nature and the position of the substituent on the susceptibility of the acid and to determine the magnitude of the methylene increment in these compounds.

The carboxylic acids used in this investigation were B.D.H. pure quality. They were further purified by standard methods in an all-glass apparatus scrupulously avoiding contamination by para- or ferro-magnetic impurities. Methyl and ethyl esters of these acids were prepared by following standard methods of their preparation. The purity of the acids as well as their esters was ascertained by determining the melting points in the case of solids and boiling points and refractive indices in the case of liquids and comparing these values with those reported in the literature.

Magnetic susceptibilities were measured by a modified form of Gouy's balance details of which have been described by Prasad and co-workers.<sup>1</sup> The error of measurement of specific magnetic susceptibility ( $\chi$ ) was in no case

greater than  $\pm 0.001$ . The results are presented in Table I in which  $\chi$  and  $\chi_m$  denote respectively the specific and molar susceptibilities of the compounds expressed in  $-1 \times 10^{-6}$  C.G.S. Units. The susceptibility contribution of the methylene group has been calculated by subtracting the molecular susceptibility of the lower member from that of the next higher member of the series. These values are given in the last two columns of the same table.

agreement in  $\chi$   $\text{CH}_2$  value obtained in passing from acid to methyl ester on the one hand and from methyl to ethyl ester on the other. Mean values of  $\chi$   $\text{CH}_2$  have, therefore, been calculated separately for the two sets of results. Thus a mean value of 10.7 is obtained for the transformation acid to methyl ester and 11.72 for methyl to ethyl ester.

It will be seen that whereas the  $\chi$   $\text{CH}_2$  value obtained from the methyl and ethyl ester:

TABLE I

Compound	Susceptibility values						$\chi$ $\text{CH}_2$		
	Acid		Methyl ester		Ethyl ester		Acid $\rightarrow$ Methyl ester	Methyl ester $\rightarrow$	Ethyl ester
	$\chi$	$\chi_m$	$\chi$	$\chi_m$	$\chi$	$\chi_m$			
1 Salicylic acid ..	0.551	75.98	0.571	86.84	0.594	98.69	10.86	11.76	
2 <i>m</i> -hydroxy benzoic acid ..	0.541	74.59	0.561	85.24	0.585	97.03	10.65	11.79	
3 <i>p</i> -hydroxy benzoic acid ..	0.536	73.92	0.556	84.43	0.579	96.11	10.51	11.68	
4 <i>o</i> -toluic acid ..	0.620	84.32	0.635	95.20	0.652	106.98	10.88	11.78	
5 <i>m</i> -toluic acid ..	0.610	82.99	0.624	93.66	0.642	105.29	10.67	11.63	
6 <i>p</i> -toluic acid ..	0.606	82.41	0.620	93.03	0.639	104.79	10.62	11.76	
7 <i>o</i> -chloro-benzoic acid ..	0.556	87.01	0.574	97.80	0.593	103.41	10.79	11.61	
8 <i>m</i> -chloro-benzoic acid ..	0.547	85.63	0.565	96.36	0.586	108.04	10.73	11.68	
9 <i>p</i> -chloro-benzoic acid ..	0.543	85.00	0.562	95.80	0.583	107.56	10.80	11.76	
10 <i>o</i> -nitro-benzoic acid ..	0.452	75.48	0.476	86.12	0.502	97.95	10.64	11.83	
11 <i>m</i> -nitro-benzoic acid ..	0.486	81.18	0.508	91.98	0.532	103.66	10.80	11.68	
12 <i>p</i> -nitro-benzoic acid ..	0.477	79.57	0.498	90.17	0.522	101.83	10.68	11.66	
13 <i>o</i> -bromo-benzoic acid ..	0.468	94.11	0.487	104.77	0.509	116.54	10.66	11.77	
14 <i>m</i> -bromo-benzoic acid ..	0.458	92.04	0.477	102.62	0.499	114.31	10.58	11.69	
15 <i>p</i> -bromo-benzoic acid ..	0.452	90.85	0.472	101.50	..	..	10.65	..	
Mean ( $\chi$ $\text{CH}_2$ ) $\rightarrow$							10.70	11.72	

French<sup>2</sup> has stated that in isomeric disubstituted benzenes when the substituents are purely meta orienting the electron density at the meta position is higher as compared to the other two positions. On the Langevin<sup>3</sup> theory of diamagnetism the susceptibility of the meta compound is expected to be higher than the other two isomers. This conclusion is supported by the observed values of magnetic susceptibilities of nitrobenzoic acids. The results of the molar susceptibilities of the remaining monosubstituted benzoic acids show that though the substituents present in these isomers have opposite orienting tendencies, the susceptibility of the para isomer in each case is lower than that of either the ortho or meta compound. A definite order, viz.,  $o > m > p$  emerges from the observed values of magnetic susceptibilities of these compounds.

The results in columns 8 and 9 of Table I indicate that the methylene increment obtained by subtracting the molecular susceptibility of the acid from that of its methyl ester is different from the one obtained from methyl and ethyl esters, the latter value in each case being approximately one unit higher. There is a close

closely agrees with the one reported for the methylene increment the former one is one unit lower. The anomalous low result for the methyl increment in passing from acid to methyl ester is in agreement with the findings of Angus *et al.*<sup>4</sup> and Khanolkar.<sup>5</sup>

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### IN VITRO METABOLISM OF RAT PITUITARY GONADOTROPHIN

WHETHER or not the gonads actually 'inactivate' pituitary gonadotrophins is a moot point. Contradictory views have been expressed in the past<sup>1-5</sup> and no unanimity has been arrived as yet. Nevertheless, there is some evidence to indicate that this hormone is actively removed from circulation by the gonads.<sup>1</sup>

As the issue involved is one of fundamental importance to reproductive physiology, a critical re-examination of the role played by the gonads in metabolism of gonadotrophic hormone seems to be in order.

The pituitaries were collected from colony-bred female albino rats (150-200 gm.) of the Institute and put immediately in chilled physiological saline solution. The glands were then quickly dried between pieces of filter-paper, weighed in a Roller-Smith balance and homogenized in chilled physiological saline solution so that 1 ml. of the homogenate corresponded to 4 mg. of wet tissue. The homogenate was subsequently incubated at 37°C. for 1 hour either separately or in combination with homogenates of ovary, liver and diaphragm from the same donor rats. The latter homogenates were prepared in such a manner that 1 ml. of each contained tissues 10 times the wet weight of the pituitary (in 1 ml. of homogenate). The ratio of the total quantity of ovarian to the pituitary tissue was found to be 10:1 and this was taken as the basis for adjustment of the ratio of the extra-ovarian tissues during the preparation of the homogenates. After incubation each preparation was centrifuged and the supernatant was used for bioassay. Immature female mice (6-8 gm.) of a Swiss strain maintained in the Institute Colony were employed as test animals. The mice were injected with 0.5 ml. of the supernatant by the subcutaneous route once daily for 3 days. The uterus was removed on autopsy 24 hours after the final injection and weighed to the nearest 0.1 mg. after drying between pieces of filter-paper. The dose of the supernatant was so adjusted that each test animal received 1 mg. of pituitary and/or 10 mg. of other tissues per injection. In a few experiments (Table I) thyroxine was added to

the preparations before incubation and each 0.5 ml. aliquot of the final supernatant contained 1 µg. of thyroxine.

The results are presented in Table I. It will be evident that under the present experimental conditions the ovary does not inactivate pituitary gonadotrophin (*b* vs. *c*— $P < .50$ ). On the other hand, the liver does inactivate the hormone (*b* vs. *f*— $P < .001$ ). This effect of liver seems to be specific because the diaphragm does not exert a comparable influence on gonadotrophin (*b* vs. *g*— $P < .10$ ). However, in the presence of thyroxine (in the incubating medium) the liver is unable to inactivate the hormone (*f* vs. *j*— $P < .001$ ). This could be imputed to the general potentiating effect of thyroxine on pituitary gonadotrophin rather than to any specific influence on the liver tissue itself (*b* vs. *h*— $P < .001$ ; *b* vs. *i*— $P < .01$ ; *b* vs. *j*— $P < .02$ ).

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#### MEASUREMENT OF PEROXIDASE ACTIVITY IN PLANT LEAF TISSUE

CATALASE, peroxidase and oxidase all three catalyse oxidation of organic compounds that are hydrogen donors, in the presence of hydrogen peroxide. These enzymes are normally present in green leaves. In plant physiological investigations comparative study rather than isolating the enzymes in pure form is often envisaged. When the measurement of peroxidase activity is made in presence of hydrogen peroxide the question of interference from catalase and oxidase therefore poses.

Apart from the fact that chemistry of the catalytic reaction of catalase, oxidase and peroxidase differs from one another, optimum conditions for their activities also differ. Advantage of this property was taken in the measurement of peroxidase activity of leaf homogenate. At pH 4.5 while the activity of peroxidase is not inhibited the interference from catalase and oxidase is eliminated (Bailey and McHargue, 1944).

Several methods have been suggested for the measurement of peroxidase activity. However

TABLE I.

Effect of various treatments on mouse uterine weight

Treatment	Mean uterine weight (mg.) with S.E.
* (a) Saline only ..	5.68 ± 0.48 (8)†
(b) Pituitary ..	14.45 ± 0.88 (11)
(c) Ovary ..	4.33 ± 0.38 (4)
(d) Liver ..	5.98 ± 0.66 (4)
(e) Pituitary + Ovary ..	13.16 ± 1.05 (5)
(f) Pituitary + Liver ..	9.00 ± 0.53 (9)
(g) Pituitary + Diaphragm ..	11.63 ± 0.74 (4)
(h) Pituitary + Thyroxine ..	17.80 ± 0.62 (16)
(i) Pituitary + Ovary + Thyroxine ..	17.29 ± 0.65 (16)
(j) Pituitary + Liver + Thyroxine ..	17.00 ± 0.56 (8)

\* Experiment No.

† Number of mice.



many of them besides being long and laborious require very rigid conditions to be fulfilled. Further, they involve the use of expensive instruments. In an investigation a number of leaf samples had to be compared for their peroxidase activity in a short period of time. For this purpose several methods were tried with suitable modifications. The one which was found more satisfactory than others is described below.

#### ENZYME PREPARATION

Three weeks old corn plants (*Zea mays*) raised in solution culture (in a plant growth chamber) were used for the experiment. One gm. aliquot portion of the leaf sample (third leaf from the top) was trichurated in a chilled mortar along with a pinch of acid-washed sand and 5 ml. of glass-distilled water. The homogenate was made to 50 ml. and after mixing well, it was filtered through four folds of cheese cloth. The filtrate was the enzyme preparation which was used for the measurement of peroxidase activity.

#### MEASUREMENT OF THE ENZYME ACTIVITY

Twenty ml. of acetate buffer pH 4.5 was taken in a 25 ml. colorimeter tube. One ml. of the enzyme preparation and 0.5 ml. of 0.05 N  $H_2O_2$  were added. At zero time 0.5 ml. of 1% aqueous solution of pyrogallol was added and change in optical density at the end of ten minutes was measured at 425 m $\mu$  using blue filter with the Fisher Electrophotometer (AC-model). The instrument was operated on regulated voltage to avoid any fluctuation in voltage affecting the instrument reading. The reaction was carried out at room temperature. The peroxidase activity was measured for six different leaf samples. The results are given in Table I.

TABLE I  
Peroxidase activity in corn leaves

(change in optical density of pyrogallol solution by enzyme preparation in presence of hydrogen peroxide)

Replication	Enzyme preparation		Reagent Blank
	Fresh	Boiled	
	(In units of the instrument dial)		
1	18.1	0.0	0.0
2	17.1	..	..
3	18.6	..	..
4	18.2	..	..
5	17.8	..	..
6	17.3	..	..

Since the plants were raised under controlled conditions there could not be much variation

in the leaf samples. The recorded results may therefore be considered as consistent.

In order to test if any of the organic components of the leaf homogenate had influenced the readings, peroxidase in one of the leaf homogenates was destroyed by boiling before the test was run. Since pyrogallol solution on exposure to atmospheric oxygen slowly changes to purpurogallin which is responsible for the change in optical density in the present method of the measurement of peroxidase activity, blank for the reagents was also run. It was noticed that neither the boiled homogenate nor the reagent blank changed optical density of the substrate. This confirmed that the recorded results truly indicated the enzyme activity. Exposure to atmosphere had very little effect on the diluted solution of pyrogallol in the buffer of pH 4.5 during the short period of ten minutes.

In Table I enzyme activity is expressed in units of the instrument dial. However the activity can also be expressed per mg. protein content of the preparation by following a convenient method described by the author elsewhere (Perur, 1961).

From the above brief discussion it may be concluded that the method described in this note may be employed with advantage for the measurement of peroxidase activity in leaf tissue whenever similar type of investigation is contemplated.

(This work was done at the Utah State University, Logan, U.S.A.)

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#### SOAKING OF PADDY SEEDLINGS IN NUTRIENT SOLUTIONS FOR INCREASED YIELD OF PADDY

NARAYANAN AND GOPALAKRISHNAN obtained a 40% increase in yields by soaking paddy seeds in a 20% solution of  $K_3PO_4$ . At the Central Rice Research Institute, the seeds were soaked for 24 hours in 2 M, M and M/2 solutions: (1)  $KH_2PO_4$ , (2)  $KHPO_4$ , (3)  $K_3PO_4$ , (4)  $NH_4H_2PO_4$ , (5)  $NaH_2PO_4$ , (6)  $Na_2HPO_4$ , (7)  $(NH_4)_2SO_4$  and (8)  $NH_4NO_3$  and it was possible to have an increased yield of 10-15%. Instead of soaking seeds in nutrient solutions for 24 hours or 48 hours, the seedlings were soaked in fertilizer soil emulsions prepared by making

a homogeneous paste with soil and a 10% solution of a fertilizer. The seedlings were treated with the pastes for 10 minutes and then transplanted in pots, care being taken to see that the material sticking to the roots fell in the root-zone.

The yields of paddy grown during 1958 and 1959 are given in Table I.

TABLE I

*Yield of paddy under different soaking treatments (In gm./pot average of five replications)*

Treatment	1958	1959
A No manure	17.04	16.46
B 10 gm. of ammonium sulphate in 100 c.c. and made into a thick paste with soil	27.23	21.36
C 10 gm. of ammonium sulphate and 10 gm. of D.C.P. in 100 c.c. and made into a paste with soil	30.95	25.86
D 10 gm. of urea formaldehyde in 100 c.c. and made into a paste with soil	24.68	21.05
E 10 gm. of urea formaldehyde + 10 gm. of superphosphate in 100 c.c. and made into a paste with soil	28.20	23.26
C.D. at 5%	9.45	1.185

Plants samples from different treatments were analysed and it was seen that treated plants absorbed more N and P due to treatment and the absorption was greatest with treatment C.

The authors' thanks are due to Dr. C. Dakshinamurthy for his valuable suggestion and guidance.

Indian Agricultural  
Research Institute,  
New Delhi-12,  
August 11, 1961.

V. ISWARAN.  
A. K. RISHI.  
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#### UNUSUAL TYPES OF TWINS IN CLINOPYROXENE FROM A DOLERITE DYKE, BANGALORE

A DOLERITE dyke with a maximum width of 7", running for nearly 20' in E-W direction, cuts across the Peninsular gneiss, about a furlong, N-W of the race course in Bangalore (N. 12° 57' : E. 77° 39'). Thin sections of the rock show various types of twins in clinopyroxenes.

Sections even from the middle part of the dyke show porphyritic texture with a glassy ground-mass. Plagioclase and clinopyroxene occur as

phenocrysts. Plagioclase is mostly lath-shaped, varying in size up to 1.5 mm. in length and 0.1 mm. in width. The anorthite content of the feldspar was determined by the Reinhard's method on four axes universal stage. The percentage varies from 53-58. Polysynthetic twins occur in most of the grains; a few grains, however, show interpenetration twins and a few grains are partly saussuritised.

Clinopyroxene varies in size up to 2.0 mm. in length and 0.5 mm. in width. The mineral is optically positive; 2V varies from 16-25°; optic axial plane is  $\perp$  to  $Q_{10}$  and  $Z \wedge C$  varies from 40-44°. The mineral is pigeonite (Hess, 1949).  $Z \wedge C$  indicates the variation of  $FeSiO_3$  from 40-61% (Bowen and Schairer, 1936; Winchell and Winchell, 1951). Pigeonite alters to green hornblende, often showing a zoned arrangement.

The following are the types of twins observed in pigeonite grains:—

(1) *Contact and polysynthetic twins*.—Twinning plane parallel to orthopinacoid (100). When such twins appear on 010 face the grains are generally elongated. This type is quite common in pyroxenes.

(2) *Interpenetration twin with twinning plane parallel to pyramid (122)*.—The twinned individuals make an angle of about 60° with the twinning plane —  $010 \wedge 122 = 59^\circ 21'$  (Dana, 1949). In one such twin, one of the individuals has developed contact twins on 100 (Fig. 1). This is an unusual combination.

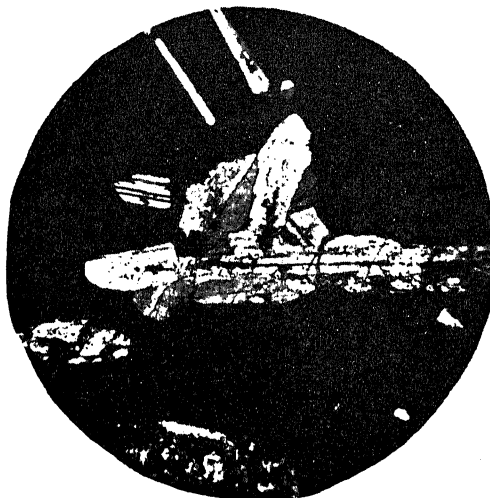


FIG. 1. Interpenetration twin in pigeonite. Twinning plane parallel to pyramid (122). Crossed Nicols,  $\times 30$ .

(3) *Interpenetration or cruciform twin*.—The twinning plane in cruciform twin is orthodome

(101). In one such twin, each individual has developed contact twins on 100 (Fig. 2). The authors have not come across any report of such a combination of twins in the available literature. The angle between  $100 \wedge 101 = 51^\circ$  (complementary :  $39^\circ$ ). This can be best obtained by measuring on 010 face, the angle between the twinning plane of the contact twin (on 100) and the twinning plane of the cruciform twin.

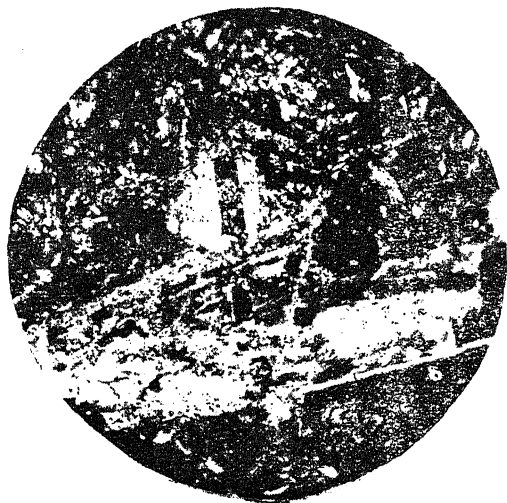


FIG. 2. Cruciform twin in pigeonite (in the middle part of the section, above the light-coloured, long grain). Twinning plane parallel to orthodome {101}. Crossed Nicols,  $\times 110$ .

High temperature and fast cooling favour the formation of pigeonite by the inclusion of a small amount of CaO in the molecule (Poldervaart, 1950), and it is preserved by quenching, in the metastable condition with an average of  $9\frac{1}{2}\%$  of CaO (Poldervaart and Hess, 1951). Interpenetration twins (on 101 and 122) in clinopyroxenes seem to be characteristic of rocks formed under volcanic conditions or of rocks formed under similar conditions such as the chilled margins of basic dykes.

The authors are grateful to Prof. M. R. Srinivasa Rao for his helpful suggestions during the course of the present work.

Department of Geology, K. G. GUBBAIAH.  
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### ON THE OCCURRENCE OF *MIOGYPSINA*, *CYCLOCYPEUS* AND *ORBULINA* IN THE MIOCENE OF ANDAMAN ISLANDS\*

THE Andaman Islands are strategically situated in the Indo-Pacific region, from the point of view of the study of the Tertiary foraminifera. The importance of certain characteristic foraminifera including *Miogypsina*, *Cyclocypeus*, *Nephrolepidina* and *Orbulina* for purposes of correlation of the Tertiary formations of the countries, including India (and the Andaman Islands) and the neighbouring countries to the east, was long recognised. A comprehensive account of such a regional correlation of the Tertiary rocks of this region was recently published by M. F. Glaessner (*Jour. Geol. Soc. Ind.*, 1959, 1).

Rich foraminiferal faunas are now recorded from the Tertiary rocks of the Long, Strait and Nicholson Islands (belonging to the Middle and South Andaman Group of Islands), collected by P. K. Chandra, Geologist (Sr.), Oil and Natural Gas Commission. It is being reported here, for the first time, the association and occurrence of *Miogypsina* cf. *irregularis*, *Cyclocypeus* sp., *Nephrolepidina* sp., *Orbulina universa* and different species of many smaller foraminifera including *Vulvulina*, *Globigerina*, *Globigerinoides*, *Globigerinella*, *Planulina*, etc., from the rocks of the Strait Island. The calcareous sandstone and limestone samples from the Nicholson Island have yielded an equally rich microfauna comprising of the same species of *Miogypsina*, *Cyclocypeus*, *Nephrolepidina*, *Orbulina*, *Globigerina*, *Globigerinoides*, and in addition a large number of smaller foraminifera including *Globorotalia*, etc. It is also recognised that a certain horizon from the same Island, containing *Orbulina*, is devoid of any larger foraminifera. Rich *Orbulina*-bearing *Globigerina*-marl is also noticed from the Long and Nicholson Islands, and a similar fauna was earlier recorded by the senior author from the Car Nicobar Islands [*Sci. and Cult.*, 1951, 17, (4)].

The *Miogypsina*-bearing rocks of these Islands are provisionally assigned a Burdigalian age. It is to be noted that we have not found an exactly similar foraminiferal assemblage from the Lower Miocene rocks of Kutch, Kathiawar, Surat-Broach, Quilon and Ceylon. The detailed study of the fauna is expected to result in delineating different local horizons and add to our

knowledge of the regional correlation of the Tertiary formations in the Indo-Pacific region.

Palaeontology Laboratory, V. V. SASTRI.  
Oil and Natural Gas Commission, T. S. BEDI.  
Dehra Dun, August 31, 1961.

\* Publication permitted by the Director of Geology,  
Oil and Natural Gas Commission.

## IONIC COMPOSITION OF THE BLOOD OF SCORPION

### I. Some Organic and Inorganic Constituents of the Blood

INFORMATION on the ionic composition of the blood of marine, freshwater and terrestrial arthropods is available.<sup>1-3</sup> However, there appears to be little work on the ionic composition of the blood of arachnids (except *Limulus*). Further, most of the earlier work was not size-controlled. It has recently been shown<sup>4,5</sup> that size and sex influence the ionic composition of the blood. But these studies were confined to a few marine and freshwater animals. It would, therefore, be of considerable interest to extend such a study to the terrestrial organisms, especially arachnids, about which little is known. The main purpose of the present investigation is to determine some organic and inorganic constituents of the blood of the scorpion, *Heterometrus swammerdami*.

It is seen from the results presented in Table I that sulphate and magnesium content of the blood is neither affected by sex nor by size of the animal. Sex does not seem to affect most of the ions (e.g., sugar, sulphate, sodium, potassium and magnesium), while size of the animal influences most of the ions (e.g., sugar, chloride, sodium, potassium and calcium). Fuller details and detailed discussion of the results will be published elsewhere.

I wish to express my sincere gratitude to Professor Kandula Pampapathi Rao, Head of the Department of Zoology, for suggesting the problem and for his kind interest throughout.

Dept. of Zoology, B. PADMANABHANAIKU.  
Sri Venkateswara University,  
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TABLE I  
Constituents of the blood of scorpion

Blood constituents	Range of values	Weight range of animals investigated (in gm.)	Effect of sex	Effect of size
Amino-acids	.. 3.8- 7.0 mg./100 ml.	3.2-12.0	Smaller males slightly higher	Nil
Sugar	.. 9.6- 96.3 mg./100 ml.	2.6- 9.7	Nil	Increases with size
Chloride	.. 150.0-450.0 mM./l.	2.6-12.2	Females higher	Increases up to 8 gm. and then decreases
Sulphate	.. 0.2- 2.8 mM./l.	3.0-11.7	Nil	Nil
Sodium	.. 150.0-335.0 mM./l.	2.5-11.7	Nil	Increases with size
Potassium	.. 0.5- 3.0 mM./l.	3.3-11.5	Nil	Slight increase
Magnesium	.. 5.0- 25.0 mM./l.	3.0- 9.0	Nil	Nil
Calcium	.. 5.0- 10.0 mM./l.	2.6-12.0	Males higher	No effect in males but increases in females

The blood was collected with the help of a hypodermic syringe, from the region of the joints of the first pair of limbs, the pedipalps, where there is a thin membrane. A wide weight range of males and females was used.

Free amino-acids, sugar, chloride, sulphate, sodium, potassium, magnesium and calcium were estimated in the blood of scorpion according to the methods given in Hawk, Oser and Summerison<sup>6</sup> and Milton and Waters.<sup>7</sup> The results are presented in Table I.

**MODE OF OVIPOSITION OF  
BRUCHOBIUS LATICEPS ASHM.  
(HYMENOPTERA: CHALCIDIDAE),  
A PARASITE ON CALLASOBRUCHUS SP.**  
*Bruchobius laticeps* Ashm. has been recorded as a parasite of several species of pulse beetles.<sup>1-4</sup> Ferriera Lima,<sup>2</sup> who has studied the mode of oviposition of this parasite, has stated that the female parasite oviposits on the mature embryos in the eggs of the host just before they hatch. Similar observations have also been made by

Chatterji,<sup>4</sup> apparently guided by the observations made by earlier workers.

Careful studies carried out in this laboratory have revealed that the parasite does not lay its eggs in the eggs of the host. It lays eggs on half to full-grown larvæ and pupæ of the host by introducing its long sclerotized ovipositor, through the hole on the seed made by the host larva. It was further observed that if a parasite egg is laid on an young host grub, it fails to develop after hatching, possibly due to insufficient food material. Chatterji<sup>1</sup> mentions that the 'females' of *B. laticeps* lay eggs on the mature embryos in the eggs of its host, mostly just before they hatch, whereas he has provided the parasites with 'not fully mature naked grubs', for oviposition. This is not clear. The parasite has a larval period of 3-5 days and it is not understood how it can successfully complete its development if eggs are laid on "mature embryos".

The present communication is intended to emphasise the need for critical studies on the life-histories and biological relationships of the numerous beneficial parasites and predators recorded from our country as new to science from time to time.

Defence Research Laboratory P. S. CHEEMA.  
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#### SOIL TREATMENT TO CONTROL ROOT-LESION NEMATODE (*PRATYLENCHUS PRATENSIS* FILIPJEV) IN TOMATO

ROOT-LESION nematode, *Pratylenchus pratensis* Filipjev, has not been previously recorded as parasitic in tomato from the Indian Union. In October 1960, samples were received from Dr. K. S. Yawalkar, Vegetable Agronomist, Indian Agricultural Research Institute, New Delhi, for examination for possible nematode infection. The roots of these plants were found heavily infected by *P. pratensis*. A subsequent survey revealed that the infestation involved a considerable portion of the field from which the original samples were collected.

#### SYMPTOMS

The young plants when attacked with root-lesion nematodes were found to lose their normal

colour and the leaves turned yellow, then whitish and became flaccid. Many such plants were killed and those that survived showed poor growth, extensive root disintegration and rot and presence of necrotic areas of varying size in the root. Late in the growing season it was observed that there was considerable reduction in the number of plants per bed as the result of severe infection that developed. There was a marked tendency for infected plants to have sparse foliage with reduced numbers of fruits. It was also noted that infected plants lost their foliage several weeks prior to plants that were not infected or only lightly infected.

#### TREATMENTS AND RESULTS

Srivastava and Katiyar<sup>1</sup> have indicated that 0.1% Diazinon gave practically complete mortality of the wheat nematodes after 24 hours. Because of the economics and low phytotoxicity of Diazinon, Dieldrin and Folidol, it was considered desirable to explore the possible value of spot application of these chemicals on *P. pratensis*.

TABLE I

Effect of some chemicals on the percentage of infestation and numbers of *P. pratensis*/gram of root tissue

Treatment	No. of plants examined	Percentage infested	No. of roots infested/plant	No. of <i>P. pratensis</i> per gram of root tissue on:			
				Jan. 2	Jan. 17	Feb. 2	Average
Diazinon	60	12	6	55	14	16	28.30
Dieldrin	60	42	31	156	216	203	191.60
Folidol	60	49	28	178	214	226	206.00
Control	60	58	39	167	210	265	214.00

The experiment was conducted in randomised plots, with four treatments, and replicated four times. A single plot consisted of three 20 feet rows and there were 13 plants in each row. The chemicals at a concentration of 0.2% were applied at the rate of 20 gallons per acre on 14th November 1960, near the root zones after removing the soil which was replaced after treatment. These were applied about 45 days after transplantation. The control plots were treated similarly with water. On January 2, January 17 and February 2, 1961, 5 plants were dug at random from each plot. The roots of these plants were removed, chopped and thoroughly mixed. Two 10 gram root samples were taken from each lot. These samples were placed in nematode extraction funnels and the number of *P. pratensis* recovered from the roots

recorded. Before making the chemical application, 5 plants from the field were dug out at random and an examination of the roots from these indicated a population of 158 *P. pratensis* per gram of root tissue. Microscopic examination was made of sections of tissues that showed evidence of discolouration or necrosis. The attacked roots showed brownish discolouration. The results of these examinations are furnished in Table I.

Diazinon materially reduced the infection percentage and the nematode population.

The author is indebted to Dr. B. P. Pal, Director, and Dr. E. S. Narayanan, Head of the Division of Entomology, for providing facilities during the course of these investigations.

Division of Entomology, S. K. PRASAD.  
Indian Agricultural Research Institute,  
New Delhi-12, July 24, 1961.

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# **"DAMPING-OFF" OF CASHEWNUT (ANACARDIUM OCCIDENTALE L.) SEEDLINGS CAUSED BY PHYTOPHTHORA PALMIVORA BUTLER IN MAHARASHTRA STATE**

"DAMPING-OFF" of cashewnut seedlings was reported in a severe form from a cashewnut nursery in Vengurla in Ratnagiri District of Maharashtra State in 1959. A species of *Phytophthora* was consistently isolated from such seedlings and proved pathogenic to healthy cashewnut seedlings in inoculation tests in a glasshouse at Poona.

The disease affects the collar region of tender seedlings in the nursery. Such seedlings turn pale and show water-soaked girdles of darkened tissue around stems. Later, affected seedlings topple over and eventually rot. In severe cases of attack the leaves also show water-soaked areas which enlarge and coalesce.

The causal organism is a typical *Phytophthora* producing sporangia and chlamydospores in culture on oat-meal agar. Sporangia which measure 50.7 (27.7-85.2) × 34 (23.2-44.1) microns are lemon or pear-shaped and have definite papillae of dehiscence. They germinate readily in tap-water producing reniform to oval zoospores. Zoospores are actively motile for a time but come to rest and germinate by germ tubes. Chlamydospores measure 36 (18-50) microns,

are ovoid to spherical, thick-walled, mostly terminal and rarely intercalary. They germinate readily producing 1-3 germ tubes per spore. Oospores were not encountered.

The fungus can grow on a variety of culture media; good growth and sporulation occurs, however, on oat-meal agar, pea extract agar and rice meal agar. Optimum temperature for growth in culture lies between 26 and 28° C.; no growth occurs below 13.5° C. and above 35° C. Sporangia germinate by zoospores up to temperatures of 20° C. and by germ tubes above 20° C.; no germination occurs above 37° C. and below 5° C. Oospores could not be obtained by growing pairs of different isolates of the organism on oat-meal agar in petri dishes. In infection experiments to determine the host range of the fungus, it caused severe rotting in fruits of brinjal, apple, tomato, Dharwar chillies (*Capsicum annum* var. *grossum*), tondli (*Coccinia indica*), and ber (*Zizyphus jujuba*), but was mildly pathogenic to fruits of mosambi (*Citrus sinensis*) and guava (*Psidium guajava*). The fungus also proved highly pathogenic to seedlings of castor but mildly pathogenic to seedlings of brinjal, tur (*Cajanus cajan*), mango and *Bryophyllum pinnatum*, while that of betelvine, potato, tomato, lime (*Citrus aurantiifolia*) and jamburi (*Citrus limon*) proved resistant.

The fungus closely resembles *Phytophthora palmivora* Butler in all its characters and it is, therefore, referred to that species.

Plant Pathology Laboratory, K. KUMARARAJ.  
College of Agriculture, V. P. BHIDE.  
Poona, August 9, 1961.

## **APHIS GOSSYPYII GLOV. AS VECTOR OF NASTURTIIUM RINGSPOT VIRUS**

RINGSPOT Viruses are rarely transmitted by insects and it is estimated that out of seventeen ringspot viruses only four are transmitted by *Myzus persicae* Sulz., *Aphis fabae* Scop., and *Brevicoryne brassicae* L.<sup>2</sup>

In the present study the disease caused by Nasturtium Ringspot Virus on garden nasturtium<sup>1</sup> has been found to be transmissible by three different species of aphides.

Virus-free colonies of *Myzus persicae* on radish, *Aphis gossypii* on cucumber, *Brevicoryne brassicae* on cabbage and *Macrosiphum pisi* Kalt. on pea were maintained. The methods of culturing and handling of the aphides were the same as those described by Watson.<sup>3,4</sup> All

transmissions were made to nasturtium seedlings from diseased nasturtium plants.

The aphides were first starved for four hours and then fed for two minutes on severely infected nasturtium leaves. Later they were transferred to healthy seedlings. The comparative tests with these different aphides were made to ascertain their efficiency and it was observed that *Aphis gossypii* is the most efficient vector in transmitting the Nasturtium Ringspot Virus. *Macrosiphum pisi* did not transmit the disease at all while *Brevicoryne brassicae* and *Myzus persicae* transmitted the disease to some extent. It was also found that the symptoms of the disease appeared much earlier in plants fed upon by *A. gossypii* than those colonised by *B. brassicae* and *M. persicae*. The efficiency of transmission of disease by *A. gossypii* increased with preliminary fasting before infection feeding. The minimum time necessary for aphides to feed on a healthy plant to produce infection was found to be one minute. Thus the aphides acquired the virus within a short time of infection feeding period and were capable of transmitting the virus to healthy plants without incubation period. Aphides when serially transferred to ten serial test plants with infection feeding time of 2 minutes in each plant and transferred immediately to next healthy plant, lost the power of transmitting the disease to healthy plants after 4th successive plant, but could cause more than one infection. The capacity to produce infection decreased with the increase in post-infection starving time and the aphides lost the power of infection when starved one hour after infection feeding period.

The above results show that Nasturtium Ringspot Virus is of non-persistent type and resembles other viruses included in this group. *Aphis gossypii* was found to be an active vector for this virus which is a new record for ringspot viruses.

The author is grateful to Professor K. S. Bhargava for suggesting the problem and for guiding the work.

Botany Department, N. S. BISHT.  
D.S.B. Government College,  
Naini Tal (U.P.), July 26, 1961.

## ON THE CAPITULUM OF *CAESULIA* ROXB.

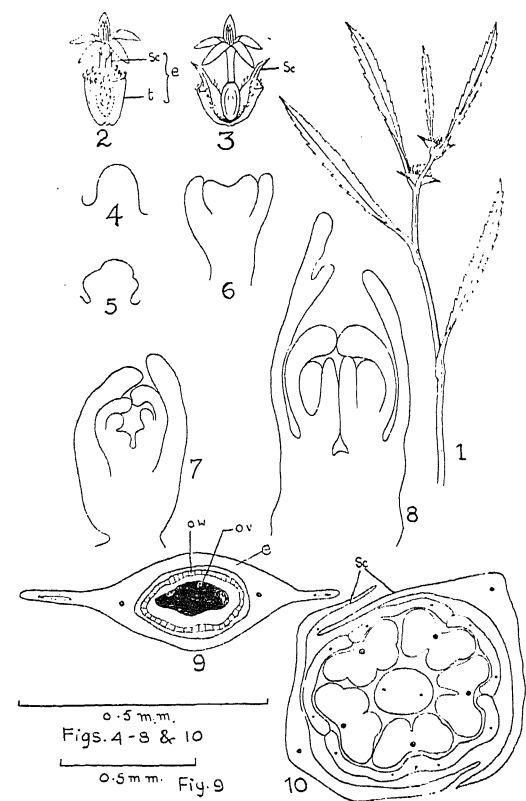
*Caesulia* is a monotypic genus represented by *C. axillaris* Roxb. which is restricted to India only.<sup>1,2</sup> According to Roxburgh,<sup>10</sup> the flower in this species is epappose and is enclosed in a two-lobed involucre. Hence, he considered that the head is actually one-flowered and, consequently, the axillary inflorescences in the species represent clusters of heads. Later, Cooke<sup>4</sup> questioned this interpretation. According to him, the parts described by Roxburgh as involucral lobes are nothing but pappus scales and as such the flower is pappose and not involucrate. He did not, therefore, consider the capitulum to consist of only one flower as described by Roxburgh. On the other hand, he suggested that each of the axillary inflorescences represents a capitulum. Cooke's interpretation is found to be followed in several floras later.<sup>5-9</sup> Further, in many other floristic treatments (e.g.,<sup>1-3</sup>), although the capitulum is described as one-flowered, its involucre is stated to be adnate to the ovary. This is, however, morphologically paradoxical because, an involucre cannot be adnate to the ovary.

The writer has taken up the present investigation with a view to clarify this confusion in the literature.

Each axillary inflorescence consists of many sessile disc-flowers clustered on a common receptacle (Fig. 1). It is subtended by a bract on each side, apart from the axillant leaf (Fig. 1). In each flower, on the top of its ovary two scales are observed lying opposite to each other, which give the appearance of a two-scaled pappus (Fig. 2). On careful dissection, however, these scales, unlike the pappus, are found to be quite free from the ovary as shown in Fig. 3. They become connate at their base and then expand downwards as a tube completely enclosing the ovary (Fig. 2). Thus, each flower is surrounded by a distinct envelope of its own which is differentiated into a distal limb and a proximal tube region. The limb is cylindrical and conspicuously narrower than the tube. Its lobes are convolute (Fig. 10) or sometimes imbricate. The tube is cuneate in shape (Fig. 2) and appears flattened due to winged margins (Fig. 9). The ovary, while young, is separate from the tube, but afterwards greatly enlarges in its size and becomes adpressed to it. There are two vascular traces passing through the margins that become the supply to the respective lobes of the limb (Figs. 9 and 10). Thus, the lobes of the

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limb and the vascular traces indicate that the envelope is diphyllous.



FIGS. 1-10. Fig. 1. Twig ( $\frac{1}{3}$  natural size). Fig. 2. Disc-flower surrounded by the envelope,  $\times 3$ . Fig. 3. Envelope dissected into two opposite halves,  $\times 3$ . Figs. 4-8. Stages showing the development of the envelope and other floral parts. Fig. 9. T.S. ovary and the tube passing through their middle. Fig. 10. T.S. flower and limb of the envelope passing above the base of the limb. (sc, scales; t, tube; e, envelope; ov, ovary; ov.w., ovary wall.)

Several primordia which are semispherical appear on the receptacle (Fig. 4). Soon after, each primordium differentiates a ring-like outgrowth below its apex (Fig. 5) which later develops into the envelope (Figs. 6-8). The floral whorls, corolla, stamens and gynæcium initiate later and develop in succession (Figs. 6-8). No structure recognisable as pappus is found to differentiate.

Since the envelope enclosing each flower is hypogynous, it obviously represents an involucre. The involucre nature is also indicated by its development which is, as in other Compositæ,<sup>10,1</sup> earlier than the floral whorls.

Thus, the head in *Cæsulia* consists of one epappose disc-flower surrounded by a two-lobed involucre as originally stated by Roxburgh. Its tube is adpressed and not adnate to the ovary as described in the literature.

It is obvious that the form of the involucre is deceptive. First because, its tube has the same shape as that of a general disc-ovary. Secondly, its narrow cylindrical limb appears as an epigynous structure and is hence mistaken for pappus. It is probably this peculiarity of the involucre which prompted Cooke and others to contradict Roxburgh.

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### THREE NEW PLANT RECORDS IN RAJASTHAN

THE plants which form the subject of this note were collected by the authors in 1956 from Khetri (Rajasthan). Since none of the published works on the vegetation of Rajasthan mentions these plants, extensive search was made and it was found that they are widely distributed in the various parts of the arid region.

1. *Cleome quinquenervia* DC.  
(CAPPARIDACEAE)

This is a Perso-Arabian species. In India it is reported only from the arid districts of the Punjab.

**Description.**—Cooke, *Fl. Pres. Bomb.*, 1958, 1, 39. This account should be supplemented as follows: Rarely up to 40 cm. high; stamens sometimes 6; seeds brown-black, glabrous, granulate.

Flowering period: August-November.  
Found only on the hills.

2. *Ifloga fontanesii* CASS. (COMPOSITAE)

This interesting taxon has been reported only from the sub-Himalayan tracts.

**Description.**—Hooker, *Fl. Brit. India*, 1881, 3, 277-78. This description should be supplemented as follows: Prostrate or erect herbs; branches 60 to 180 mm. long, 20 to 25 mm. across the leaves; leaves alternate at the base and clustered above; pappus sometimes white.

Flowering time: January-April.  
Prefers sandy soil.

3. *Micrococca mercurialis* BENTH.  
(Syn. *Claoxylon mercurialis* THW.)

This member of the Euphorbiaceae is generally found only in the humid regions of India. None of the floras of Northern India mentions this species.

**Description.**—Cooke, *Fl. Pres. Bomb.*, 1958, 3, 107. This description should be supplemented as follows: Branches sparsely hispid; large number of stalked glands in the axils of leaves; stipules minute, often caducous, stamens 3 or 4, rarely 6 (they were never 10 in the material examined); seeds non-strophiolate, albumen fleshy, cotyledons flat.

Flowering season: July-November.

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Birla College, Pilani, T. A. THOMAS.\*\*  
August 18, 1961.

Present address:

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\*\* Indian Agricultural Research Institute, New Delhi.

### CHROMOSOME NUMBER OF SOME WILD ORNAMENTAL SHRUBS OF KULU VALLEY

KULU VALLEY forests abound in some very ornamental bushes. Some of these are wild relatives of the genera that are already under cultivation, while others though not under cultivation, can be introduced in our gardens as ornamental bushes. The cytological studies of three of these, viz., *Prinsepia utilis* Royle, *Deutzia staminea* R. Brown and *Hypericum cernuum* Roxb. were undertaken while studying their suitability in our gardens as ornamental shrubs.

*Prinsepia utilis* (Fam.: Rosaceae) is a common wild bush growing from 3,000 to 8,000 feet altitude and flowers during January and February, when no other shrub either cultivated or wild is in bloom. *Deutzia staminea* (Fam.: Saxifragaceae\*) is a white flowering shrub found from 3,000 to 9,000 feet above sea-level and comes into flowers from March to May. *Hypericum cernuum* (Fam.: Hypericaceae) is a yellow flowering shrub found growing in rocky soil from 5,000 to 7,000 feet altitude and comes into flower from March to May.

The chromosome number of these three wild shrubs were determined (Table I) and these are believed to be new as they have not been listed in the chromosome number compilations by Darlington and Wylie (1955).<sup>1</sup> However, the chromosome number of some of the cultivated species have already been reported in the genera *Deutzia* (Sax, 1931 b and Schoennagel, 1931)<sup>4,5</sup> and *Hypericum* (Hoar and Haertl, 1932 and Maude, 1939).<sup>2,3</sup>

TABLE I

Sl. No.	Name of the plant	Family	Chromosome number (n)
1	<i>Prinsepia utilis</i> ..	Rosaceae	16
2	<i>Deutzia staminea</i> ..	Saxifragaceae	13
3	<i>Hypericum cernuum</i>	Hypericaceae	24

\* In Hutchinson's classification this genus is included in the family Hydrangeaceae.

The chromosome numbers were studied at meiosis and based on acetocarmine preparations of the PMC at diakinesis, metaphase I and anaphase I (Plates I, II and III), are listed in Table I.

In all the plants examined the meiosis was quite regular and four pollen grains were formed of each pollen mother cell after regular separation of the chromosomes. The chromosome counts of all the three bushes fit well with the basic chromosome number proposed by Darlington and Wylie (1955).<sup>1</sup>

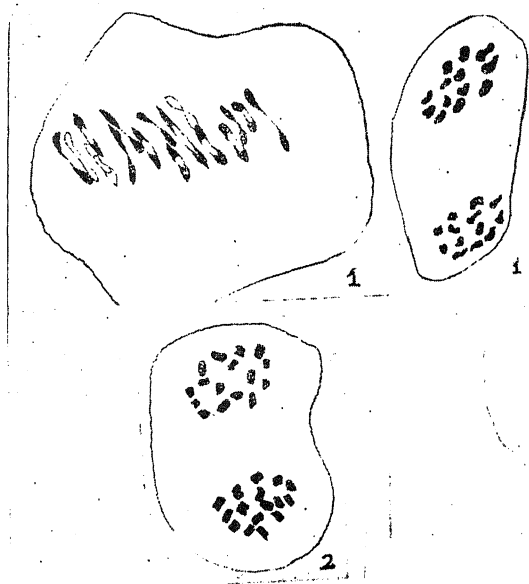


PLATE I

Plate I

FIGS. 1-2. *Prinselia utilis*. Fig. 1. Camera lucida drawing showing 16 bivalents at metaphase I,  $\times 1,250$ . Fig. 2. Camera lucida drawing showing 16 chromosomes at anaphase I,  $\times 1,250$ .

Plate II

FIGS. 1-3. *Deutzia staminea*. Fig. 1. Camera lucida drawing of anaphase I showing 13 chromosomes at each pole,  $\times 1,250$ . Fig. 2. Metaphase I showing 13 bivalents,  $\times 1,250$ . Fig. 3. 13 bivalents at late diakinesis the nucleolus has disappeared,  $\times 1,250$ .

Plate III

FIGS. 1-2. *Hypericum cernuum*. Fig. 1. Camera lucida drawing of diakinesis showing 24 bivalents,  $\times 1,250$ . Fig. 2. 24 bivalents at metaphase I,  $\times 1,250$ .

Our thanks are due to Dr. B. P. Pal, Director, Indian Agricultural Research Institute and Dr. S. K. Mukherjee, Head of the Division of Horticulture of the Indian Agricultural Research Institute, New Delhi, for their encouragement during the course of the investigations.

Indian Agric. Res. Inst., J. N. SHARMA.  
Vegetable Breeding Substation, VISHNU SWARUP.  
Katrain (Kulu Valley),  
Punjab (India), July 10, 1961.

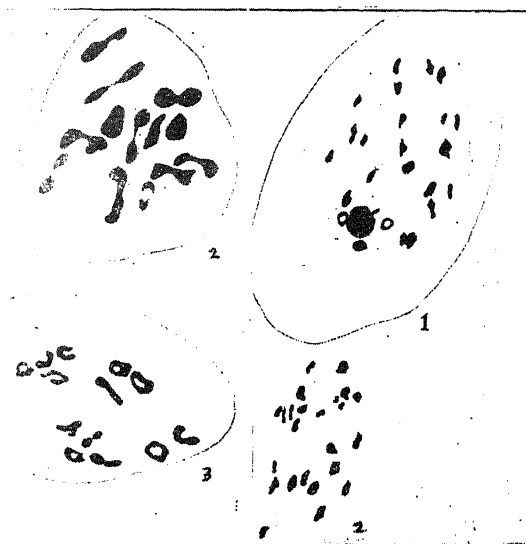


PLATE II

PLATE III

# SALTATION IN *HELMINTHOSPORIUM ORYZAE* BRED A DE HAAN

MATSUURA (1930) observed that *Helminthosporium oryzae* salted readily to form white patches at  $28^{\circ}\text{C}$ ., saltation being conditioned by temperature and the medium. Chattopadhyay and Das Gupta (1958) observed saltation in several isolates of *H. oryzae* grown on Richards' agar, Maize meal agar and Oat meal agar.

In the present studies several other media were also tried to see their effect on saltation. The fungus was isolated from diseased paddy plants, raised at the Rice Experimental Area, Sabour, brought into pure culture and grown in the following synthetic and non-synthetic media at  $28^{\circ}\text{C}$ . The pH was adjusted to 6.0. The cultural characters were as follows:—

**Brown's Agar Medium.**—Colony uniform, circular, margin entire, aerial, fluffy, non-compact, olive-green, spreading, mycelium colourless.

**Glucose Peptone Agar Medium.**—Colony uniform, circular, margin entire, mycelial growth profuse, compact, uniformly aerial, dark olive green, turning greenish black.

**Richard's Agar Medium.**—Colony uniform, circular, mycelium colourless, non-aerial, non-compact, olive green, mycelium spreading.

**Czapeczk's Agar Medium.**—Colony uniform, circular, margin entire, slow-growing, non-compact, mycelial strands olive green.

1. Darlington, C. D. and Wylie, A. P., *Chromosome Atlas of Plants*, 1955, 114, 134 and 142.
2. Hoar, C. S. and Haertl, E. J. *Bot. Gaz.*, 1932, 93, 197.
3. Maude, P. F., *New Phytol.*, 1939, 38, 1.
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**Coon's Agar Medium.**—Colony uniform, growth scanty, whitish mycelium, cottony, spreading slowly.

**Knopp's Agar Medium.**—Colony uniform, circular, mycelium colourless, non-aerial, non-compact, slow spreading.

**Potato Dextrose Agar Medium.**—Colony circular, uniform, margin entire, mycelial growth thick, compact, profuse, dark olive-green, later turning blackish.

**Oat Meal Agar Medium.**—Colony circular, uniform, margin entire, mycelial growth not compact, olive-green, slow spreading.

**Maize Meal Agar Medium.**—Colony irregular, growth compact to non-compact, olive green, slow spreading.

**Host Extract Agar Medium.**—Colony circular not uniform, developing alternate dark and light bands in circular fashion, sectoring common, slow-growing, olive-green, non-compact.

In Host Extract agar the growth rate and colony characters of the fungus were markedly different from those in other media and fan-shaped sectors developed after 4 to 8 days incubation at 28° C. The sectors were light olivaceous-green in colour and composed of greyish hyphæ without any concentric zonation in the sector area. Sporulation was completely absent.

The growth of the saltant was later studied in the following solid media.

Potato Dextrose agar, Oat meal agar, Czapeck's agar, Brown's agar, Coon's agar and Glucose peptone agar.

In Potato Dextrose and Glucose peptone agar, very pronounced sectors developed. In contrast to this, in Brown's and Coon's media the growth was scanty, whitish, non-compact, slow-spreading and the sectors were not prominent. In none of the media, zonation developed.

Light had no effect on saltation, as the sectors developed equally well both under light and darkness.

Dept. of Plant Pathology, A. P. MISRA.  
Bihar Agricultural College, A. K. MUKHERJEE.  
Sabour, June 19, 1961.

### **CERCOSPORELLA INDICA SP. NOV.**

The present note describes a new fungus discovered by the author in the course of his study of "The Mycoflora of Muzaffarpur, Bihar".

In the early winter of 1959 *Ipomea* sp. leaves were found affected by a peculiar disease. It was again observed in 1960 and also in the current year. Normally the lower mature leaves are infected but in some even the young leaves at the top are infected.

The fungus appears on the lower surface of the leaves as frosty-white mildew and mainly as small angular areas between the finer veinlets. Due to the abundance of the fruiting hyphæ and the limitations of veins, an areolated appearance is presented.

The pathogen is wholly within the tissue of the host and only the conidiophores emerge through the stomata in bundles of 2-3. The mycelium is intercellular flexuous measuring 95  $\mu$ -117  $\mu$ . The conidia are solitary, terminal, oval-oblong and one septate. As it enlarges it becomes elongated and 2-3-septate. Subsequent production of conidia is sympodial. Conidiophore puts forth lateral projections and buds out conidia. At a later stage the conidiophore is little zigzag in outline. The size of the conidia varies greatly 28  $\mu$ -42  $\mu$ .

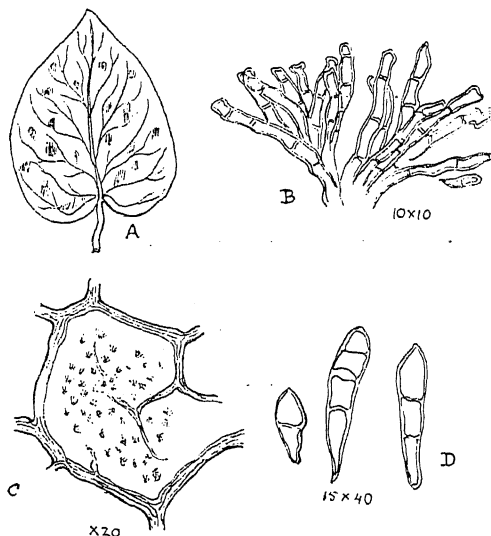


FIG. 1. *Cercospora indica* sp. nov. A, Infected leaf showing typical symptoms; B, Conidiophores with geniculations; C, Interveneal fruiting-hyphæ; D, Conidia.

#### **LATIN DIAGNOSIS**

*Cercospora indica* THAKUR SP. NOV.

In pagina inferiore foliorum ut rubigo nivea et paecipue ut maculae parvae inter nervos tenuiores. Areolae apparent ob abundantiam

1. Chattopadhyay, S. B. and Das Gupta, C., *Indian Phytopath.*, 1958, **11**, 144.
2. Matsuura, I., *Trans. Tottori. Soc. Agri. Sci.*, 1930, **11**, 6482.

hypharum fructificatium et limites nervis definitos.

Fungus penitus in plantæ hospitis textibus transversus conidiophoris solis per stomata emergentibus fasciculatis 2-3. Mycelium intercellulare et hyalinum. Conidiophori septati, hyalini et flexuose, magnit.  $95\mu$ - $117\mu$ . Conidia solitaria, terminalia, ovalia vel oblonga, semel septate, evadentia 3-septata. Conidiophori conidia producunt sympodice, projectionibus lateralibus emis. Tandem conidiophori geniculati evadunt. Conidia magnitudino multum varient,  $28\mu$ - $42\mu$ .

The fungus has been put under the genus *Cercospora* of Moniliales. As far as the author can determine, this is the first time a record of this is made in India on this host. A similar collection on the same host has been made at Uganda (Africa) but the Uganda material shows longer and narrower Conidia which are 1-3-septate, mostly 2-septate. As the genus *Cercospora* collected here in India is peculiar and different from that of Uganda, Africa, I propose *indica* as the specific name of the fungus.

The specimen has been deposited in the Herbaria of the Commonwealth Mycological Institute, Kew, No. IMI. 85165.

The author expresses his gratitude to Dr. J. C. F. Hopkins, Director, Mr. F. C. Dieghton, Assistant Mycologist, Commonwealth Mycological Institute, Kew, England, for the identification of the specimen and to Rev. Fr. Prof. H. Santapau, Bombay, for the Latin diagnosis.

Dept. of Botany, THAKUR K. S. SINGH.  
L.S. College, Bihar University,  
Muzaffarpur, July 24, 1960.

# OCCURRENCE OF *CERCOSPORA* *RUBROTINCTA* Ell. AND Ev. ON CHERRY IN INDIA

SWEET CHERRY (*Prunus avium* L.) is grown in the Orchards of Kashmir Valley in large numbers. These trees throughout the Valley are subject to a serious leaf spotting disease caused by *Cercospora rubrotincta* Ell. and Ev.

The disease is observed in the field during the first week of June and is characterised by the appearance of small circular reddish brown spots with dark red margins (Fig. 1a). The spots are formed on both the surfaces of leaves. They are mostly single, rarely coalescent, with a diameter of 2-5 mm. These may be few or sometimes so numerous as to cover the major portion of leaf surface. Towards the end of June, these leaves develop pronounced chlorosis of the leaf tissue, as a result of which leaf

appears either mottled or completely yellow. During the rest of the season, these trees present a striking yellow appearance. Rarely shothole symptoms also develop. Early defoliation of the trees sets in due to the disease, resulting in reduced vigour and outturn.

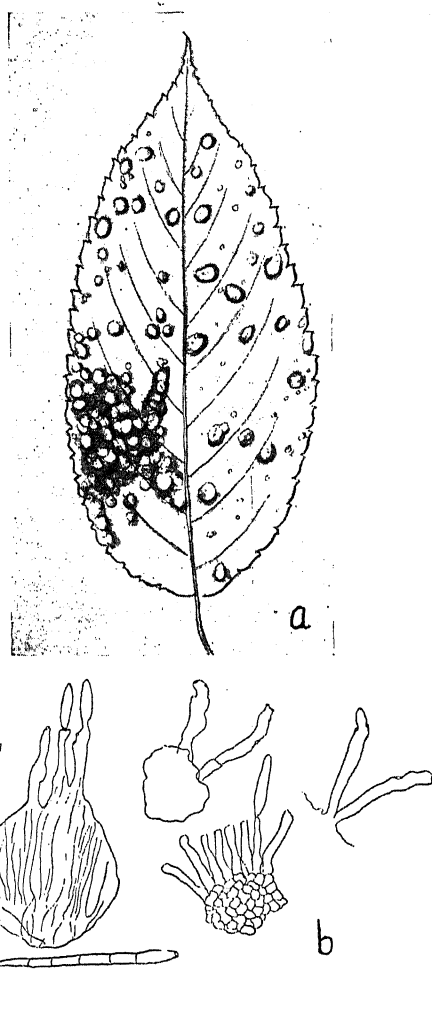


FIG. 1. (a) Leaf showing infection spots (natural size). (b) Conidia, conidiophores and stroma,  $\times 325$ .

During the middle of July, the centre of these lesions turn greyish white or tan-coloured and the fructifications of the causal organism develop in these areas as minute black dots. These black dots constitute fascicles of dark brown-coloured conidiophores. The conidiophores are in loose or dense fascicle which may be simple or sometimes coremioid, geniculate, thick-walled, olive brown in colour, numerous arising

from a prominent stroma (Fig. 1 b). The fascicles arise on both the leaf surfaces and are initially sub-epidermal. The conidiophores (Fig. 1 b) are 0-3 septate, straight or slightly curved, measure 20-45  $\mu$  in length and 3-5  $\mu$  in breadth. Conidia (Fig. 1 b) are hyaline, acicular, straight or curved, with a truncate base and pointed but obtuse apex, closely septate with 3-8 septa (usually 3-5 septa) and measure 40-65  $\times$  4-5  $\mu$ .

This disease bears a close superficial resemblance to the leaf spot of cherry caused by *Coccomyces hiemalis* Hig. so common in other countries. The disease is being reported for the first time from India. The specimens have been deposited in Herbarium Cryptogammæ Indiæ Orientalis, New Delhi.

The author is grateful to Mr. R. L. Munjal, Systematic Mycologist, Indian Agricultural Research Institute, New Delhi, for help in this investigation.

Mycology Section,  
Fruit Research Station,  
Lalmandi, Srinagar (Kashmir),  
August 21, 1961.

T. N. KAUL.

### APPROPRIATE BASIS FOR EXPRESSION OF CHLOROPHYLL CONTENT\*

Most workers in the past have expressed chlorophyll data either on fresh or on dry weight basis. Few workers have used leaf area for this purpose. Variations in water content of leaves and growth characteristics pertaining to dry matter accumulation and leaf area expansion mainly obscure the real expression of chlorophyll content as the plant advances in age. Although it seems practically impossible to find an absolutely non-variable basis for this purpose, it would be desirable to have the least variable one. An attempt was, therefore, made to find out an appropriate basis for chlorophyll expression during the course of studies on 'Chlorophyll development in wheat and its relation to plant vigour and manurial treatments'.

Wheat variety Pb-591 was sown in the first week of November 1950 on a field which had sandy loam soil of average fertility. The crop received 30 lb. N, all at sowing in the form of ammonium sulphate. The field was divided into four blocks and plants were collected separately from these blocks to obtain truly representative samples. Observations on chlorophyll content, area, fresh and dry weight of leaves were made at successive stages of growth in respect of four cate-

gories of plants, viz., vigorous, normal, sub-normal and poor. However, for purposes of this note the data pertaining to the two extreme classes, viz., vigorous and poor only have been used. Plants were selected and classified into these categories on the basis of their general condition as judged by the foliage colour, height and number of tillers, etc. There existed enough variability with regard to plant size and vigour in the experimental crop. Each figure used here is an average of ten individual estimations.

Plant material was collected in the forenoon between 10 a.m. and 12 noon. Sample plants were wrapped in wax paper and brought to the laboratory covered in a black cloth. In the laboratory the leaves were detached and three representative leaves per plant were traced out on a paper for subsequent determinations of the area with the help of a planimeter. They were then chopped into small pieces (2-3 mm. in size). 0.5 gm. to 1.0 gm. of chopped material was used for chlorophyll extraction and 1 to 5 gm. was used for finding dry weight.

For the quantitative extraction of chlorophyll 'a' and 'b' from the leaves the method of Schertz (*Plant Physiology*, 3, 1928) was followed with necessary modifications. For quantitative estimation of chlorophyll, Rouy's photoelectric colorimeter was used after appropriately calibrating it for chlorophyll estimations. Chlorophyll content in leaves was expressed both on dry weight and leaf area basis.

### RESULTS AND DISCUSSION

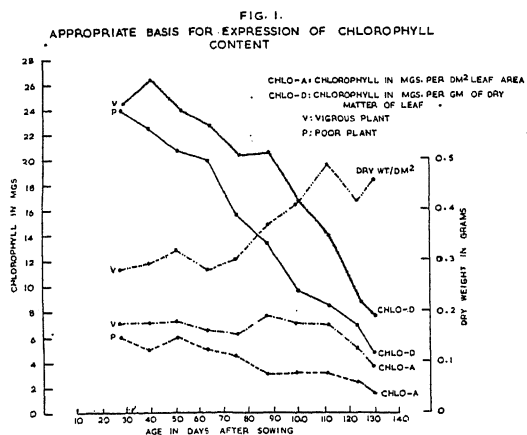
Figure 1 depicts the changes in chlorophyll content in leaves of a vigorous and a poor wheat plant. The corresponding data are presented in Table I.

TABLE I  
Chlorophyll content in leaves of wheat Pb-591  
at successive stages of growth

Days after sowing	Chl-a (mg.)		Chl-d (mg.)	
	V	P	V	P
28	7.04	5.99	24.45	24.03
40	7.14	5.05	26.56	22.58
52	7.21	6.17	23.98	20.71
64	6.48	5.09	22.82	20.14
76	6.18	4.53	20.55	15.70
88	7.71	3.16	20.65	11.39
100	7.00	3.26	16.89	9.76
112	6.99	3.23	14.19	8.57
124	4.91	2.47	8.82	6.92
130	3.63	1.62	7.84	4.65

Chl-a : Chlorophyll on area basis; Chl-d : Chlorophyll on dry weight basis; V : 'Vigorous' plant; P : 'Poor' plant.

Curve representing chlorophyll content per unit dry weight of leaves of vigorous plants shows a regular decline as the plant advances in age indicating that there is an inverse relation between development of chlorophyll per gm. of dry weight of leaf and age of the plant. On the other hand, dry matter per unit area shows a steady increase with age of the plant. The interaction effect of these two opposite trends was clearly brought out by the curve representing chlorophyll content per unit area of leaves. Chlorophyll content per unit leaf area (Chl-a) showed comparatively much lesser decline with age in comparison to chlorophyll content per unit dry weight (Chl-d).



Growth characteristics pertaining to dry matter accumulation in leaves, leaf area expansion as well as chlorophyll development in leaves vary a great deal with age. While maxima for chlorophyll content are achieved soon after emergence of a leaf, the expansion in the leaf area continues for some time after that. The dry matter accumulation is slow to begin with but assumes a much faster rate during later stages and continues for a much longer period. These responses obscure the actual trend in chlorophyll development when dry matter is used as a basis for chlorophyll expression. On the other hand, leaf area is a function of internal capabilities of the plant and as such is less variable within limits of the variability characteristic of a particular plant species. This has also been substantiated by the results reported here. It may be inferred, therefore, that unit leaf area is a much appropriate basis for expressing the chlorophyll content than dry matter of leaves.

Indian Agri. Res. Institute, O. P. GAUTAM.\*\*  
New Delhi, August 24, 1961.

\* Contribution from the Department of Agronomy, B.R. College, Agra.

\*\* Formerly Head of the Department of Agronomy, B.R. College, Agra. Currently Head of the Division of Agronomy, Indian Agricultural Research Institute, New Delhi-12.

## STUDIES INTO HABITAT AND GROWTH OF POLYPOREACEAE (PORE FUNGI), *HEXAGONA VARIGATA*, *NOVO ORIENTALIS*

THE above species was detected in Saktesh Garh (Distt. Mirzapur) by the author, during a tour in the area for a large-scale collection of other species of the family, during the year 1959-60 for collection of data to be incorporated into a thesis as a part fulfilment to the degree of Master of Science in Agriculture of the Banaras Hindu University, Varanasi.

In a personal communication to the author, Dr. Rogers, Prof. of Mycology in the University of Illinois, U.S.A., identified the character of this species, intermediate between *Hexagona* and typical Polypores. This is the first report of occurrence of this variety in India. Figure 1 shows the Hymenial surface of the fungus, which is a saprophyte on the dead trunk of trees.

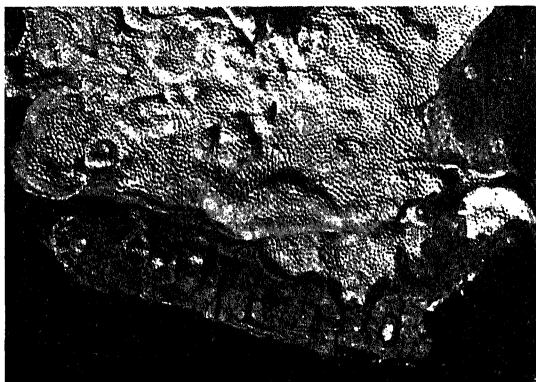


FIG. 1

The characters of this fungus are:

*Pileus*.—Resupinate to sessile, friable to flexible when fresh, somewhat flexible when dry, reddish white in colour or reddish tints.

*Context*.—White, less than 1 mm. thick, soft.

*Upper surface*.—Unzoned, not hairy, smooth, deep brown in colour.

*Hymenial Surface*.—Reddish-white in colour or grey-coloured, pores are hexagonal to sub-circular, averaging 3-4 per mm. not clearly visible by unaided eye. While in the case of

*Hexagona varigatus*, pores are 1-1.5 per mm. and are very shallow. Pore tubes are about 0.5 mm. long.

**Spores.**—Not observed, hyphae simple, no septa or clamps are observed.

The author is thankful to Dr. A. Lal, and Prof. V. P. Tiwari for their helpful suggestions and guidance.

G.A. Degree College,  
Rampur, Saharanpur (U.P.),  
September 4, 1961.

S. N. SINGH.

### CHROMOSOME NUMBER IN *CAPPARIS DECIDUA* PAX.

THE members of the family Capparidaceae, which is predominantly tropical, are represented in India by 53 species distributed among eight genera. Of these as many as 31 belong to the genus *Capparis*.<sup>1</sup>

Cytological work on the members of this family is meagre. Raghavan and his collaborators<sup>2-9</sup> started a systematic study of the cytological and cytomorphological features of this family several years ago, and quite a few genera have been covered. So far as is known, *Capparis decidua* has not been investigated up till now. Recently, Vaidya has reported twin embryo-sacs in this species.<sup>10</sup> This is a common species in the drier parts of Gujarat and Maharashtra. Materials for the present study were obtained from Vallabh Vidyanagar where the plant grows wild in abundance. Flower-buds were fixed in acetic alcohol. Prefixation in carnoy's fluid did not show any marked advantage. Acetocarmine smears were made of the fixed as well as fresh material. Anthers were also fixed in propionic alcohol saturated with ferric acetate, fixation being carried out at low temperatures. These were smeared using propionocarmine as the stain. Slides were made permanent in the usual way, employing butanol.

The chromosome number from meiotic counts showed  $n = 22$ , which has not been reported so far. It is of interest that no member of this family so far investigated has been found to possess this number.

On the basis of secondary association the basic chromosome number for the family has been suggested to be  $x = 7$ .<sup>6,9</sup> From this, secondarily balanced basic numbers presumably have arisen and the various genera represent different balances of these numbers. It will be seen from Fig. 1 that the M I plate shows the bivalents

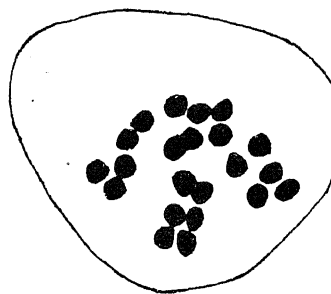


FIG. 1. *C. decidua* Pax,  $\times 2,000$

secondarily associated. The groupings have not yet been statistically analysed. Prochromosomes, first reported in *Polanisia trachysperma*<sup>4</sup> and *Gynandropsis pentaphylla*,<sup>4</sup> are also a feature here, but is of special interest, in that it has not been reported in the previously investigated species of *Capparis*, namely *C. zeylanica*<sup>9</sup> and *C. sepiaria*.<sup>3</sup> However, secondary association was found in *C. zeylanica*.<sup>9</sup>

The work is being conducted under the guidance of Professor T. S. Raghavan to whom I am deeply indebted.

Dept. of Botany, A. O. N. PANIKKAR.  
Sardar Vallabhbhai University,  
Vallabh Vidyanagar,  
July 25, 1961.

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3. —, *Ann. Bot. N.S.*, 1938a, **11**, 75.
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5. —, *Jour. Linn. Soc. Lond.*, 1939, **52**, 238.
6. — and Venkatasubban, K. R., *Cytologia*, 1939, **10**, 23.
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## REVIEWS

**Progress in Nuclear Energy—Reactors, Vol. II.** Edited by H. R. McK. Hyder. (Pergamon Press, Ltd., Headington Hill Hall, Oxford), 1961. Pp. vi + 557. Price £ 5.5 sh.

The publication series *Progress in Nuclear Energy* of the Pergamon Press is well known. It forms an authoritative medium for the presentation of review articles on all aspects of atomic energy. It provides the interested readers with the latest information on the topics dealt with.

The book under review, *Reactors*, is the second volume in a series of twelve planned to cover the proceedings of Second International Conference on the Peaceful Uses of Atomic Energy held at Geneva in 1958. There are 19 review papers on various problems connected with Reactors, their design and operational features. In a brief review like this it is not possible to do full justice to all the articles. We shall be content with mentioning only a few.

The first article deals with the two zero-energy fast reactors Zephyr and Zeus that have been built and operated at Harwell. Experiments on these reactors yield data leading to a further understanding of neutron physics. Also measurements in a low power system give practical information highly useful in designing power reactors.

In another article results achieved with altered designs and operational features in what is known as the Homogeneous Reactor Experiment-2 at Oak Ridge National Laboratory are discussed in detail by the members connected with the project.

Brookhaven researches on the study of uranium-water lattices discussed in one of the articles report data which will be of great help in tackling theoretical problems connected with pressurized-water reactor cores.

In an article entitled "Studies in the Physics of Fast Neutrons", USSR scientists have presented the results obtained at the Institute of Physics of the Atomic Energy Department with the three breeding reactors (conversion factor greater than unity) BR-1 (started in 1955), BR-2 (1956) and BR-3 (1957).

The article "An appraisal of the Enrico Fermi Reactor" at Detroit, Michigan, gives a critical evaluation of the development design of the plant in the light of present knowledge.

This compact volume on reactor physics and technology should prove a very useful guide to all those actively engaged in the design and operation of reactors. A. S. G.

**Physical Chemistry of Process Metallurgy, Parts I and II.** Edited by George R. St. Pierre. (Interscience Publishers, New York), 1961. Pp. xiv + 644, 645-1,374. Price \$ 22.50 and \$ 25.00.

These two books contain the contributions and discussions at the International Symposium on the Physical Chemistry of Process Metallurgy held in Pittsburgh April 27 through May 1, 1959, conducted under the auspices of the Metallurgical Society of the A.I.M.E.; the third in the Conference series dealing with Process Metallurgy. The wide and broad coverage of the subject is clearly evidenced by the superb quality of the contributions and the international character of the participants, viz., from England, Japan, U.S.A., Canada, Belgium, France and Australia. The importance and need for such a Conference can be impressed by the facts like the lack of proper present knowledge of physical, chemical and thermodynamic data, of the structural characteristics of liquid metals and the lack of correct quantitative evaluation of a given process.

In a Conference of this nature which has to make several adjustments though a number of topics have been handled a few have perforce been left out and the contents in the volume Parts I and II have been arranged for convenience under some 13 sections in all, captioned by suitable headings.

The book Part I has six sections, dealing with certain aspects of the subject under appropriate captions, a few contributions in each.

The book opens with three important lectures on the present position, future and application of physico-chemical measurements in general and metal solutions and slags in particular.

Section I deals with the physical chemistry of metallurgical phases and contains three papers and the discussions thereon.

Seven papers follow next under the caption Physical Chemistry of Oxide Phases in Section II. Very useful information is covered in the reported thermodynamic, statistico-thermodynamic, and some structural studies of molten slags and oxides.



Thermodynamics of metals is dealt with under some 6 papers in Section III. High temperature studies of vapour pressure by various techniques and activity measurements of carbon and oxygen in iron and of aluminium in aluminium-iron alloys of great significance to the iron and steel metallurgist form the subject-matter.

In Section IV, the nature and structure of liquid metals, particularly X-ray diffraction studies, the nature of immiscibility, electrolysis and diffusion and activation energy are discussed in some seven papers which follow next.

The mechanism of transport and mixing dealing with aspects like electron-migration, self-diffusion, kinetics of reactions and mass transfer are covered in some 6 excellent papers by well-known workers in the field.

The last Section No. VI in the book Part I deals with the solubility and phase equilibria in metal systems and contains some 4 papers describing a new apparatus for solubility measurements, the application and utility of controlled solidification and some solubility studies.

The book Part II opens with the caption 'Process Reactions Rates and Mechanisms' under Section VII and deals with the now-popular fluidized bed technique, kinetics and mechanisms of certain reactions under certain specified conditions, in some 7 papers.

Solidification of metals, its nature, effects of electrical field and under cooling and grain size control form the subject-matter in some 5 papers which follow next in Section VIII.

Under Section IX are discussed the properties of halide and sulphide melts particularly, the constitution, heats of formation, phase equilibria, thermodynamic considerations and studies on copper, all matter of considerable metallurgical interest in the light metal industry.

Section X deals with industrial application and principles, particularly solubility data of interest in lead refining, temperature considerations regarding furnace tapping, ingot/teeming in steel making, purification of iron melts by vacuum fusion, the LD-AC Process, the mechanism of titanium's detrimental role in the blast furnace burden and certain mechanisms of interest in steel-refining.

Next follows in Section XI, 3 papers on the important factors affecting sulphur control in the blast furnace, and those affecting sulphur and phosphorus control in basic electric steel production.

Some aspects of interest in extraction of zinc and nickel are discussed next in Section XII.

And lastly, under the caption 'Process Control and Statistical Methods' is discussed their role, application and importance and a mathematical model of significance in the open-hearth practice.

The text in the book has been well supported by a number of tables, graphs, illustrations, micro-photographs, X-ray crystograms and electron diffraction patterns wherever necessary. It needs hardly be stressed that these two books, though of special interest to the serious researcher in the Process Metallurgy, are of equal significance to the practising extraction metallurgist and the chemist.

A. A. KRISHNAN.

**X-Ray Analysis of Organic Structures.** By S. C. Nyburg. (Academic Press, Inc., London and New York; India: Asia Publishing House, Bombay-1), 1961. Pp. xii + 434. Price 93 sh.

X-ray crystallography is playing an ever-increasing role in elucidating the structure of the solid state, and it has become a recognised tool of research in organic and biochemical laboratories. With the improved methods and instrumental technique currently available the growing of crystals for X-ray studies and taking the diffraction photographs have become a matter of routine. But in interpreting the results and carrying out the structural analysis a considerable amount of mathematics is involved. Most of the available text-books on the subject do not make any concession to the organic and biochemists who use this research tool but generally are not mathematically endowed and loathe to wade through the intricacies of complex algebra and reciprocal spaces. In this context the book under review will be welcomed by a large number of research workers in the field of organic X-ray crystallography.

In the first six chapters, which cover about a third of the book, the general method of X-ray structure analysis is given with the minimum of formal mathematics, and the topics dealt with include the unit cell, the space group and the molecule, the intensities of X-ray reflections, and Fourier, analysis and the phase problem.

The remaining two-thirds, namely Chapters 7, 8 and 9, give a survey of the organic and biological materials which have so far been examined. For this survey the organic materials examined to date have been divided into three groups, viz., (a) Chapter 7, Crystalline materials of low molecular weights (aliphatic, aromatic, alicyclic, hetrocyclic, and organo-metallic compounds); (b) Chapter 8, Crystalline macromolecular materials (globular proteins, ribo-

nuclease, insulin, hæmoglobin, viruses, etc.), and (c) Chapter 9, Fibrous materials, which include polymers, polysaccharides, fibrous proteins, nucleic acids and nucleo-proteins.

Students who are new to crystallography will be benefited by the book as a whole, and even experts in the field will find the comprehensive survey and references to date compiled at the end of each chapter useful.

A. S. G.

### Cambridge Aeronautical Series

The Theory of Subsonic Plane Flow. By L. C. Woods. (Cambridge University Press, London N.W. 1), 1961. Pp. xxii + 594. Price 120 sh.

The third of the series treats subsonic, inviscid, two-dimensional flow with the aid of the complex variable. Part I, 70 pages, surveys the flow field, accounting for the compressibility through the "tangent-gas" approximation, formulates linear theories and introduces the complex function  $\Omega + i\theta = \gamma(\phi + i\psi)$ , Part II, 130 pages, isolates the mathematics required, treating in detail mixed boundary value problems. By itself a monograph on the complex variable, this part deals with Cauchy integrals and their application to harmonic functions, elliptic functions and the Riemann-Hilbert and Poincaré problems. Fifty pages are devoted to conformal transformations. Part II will interest everyone working with the complex variable. Parts I and II develop all the material necessary to understand the rest of the volume.

Part III, 375 pages, deals in the main with problems in aeronautics. Labelled "Applications", the author describes the body of the work as determining  $\tau$  for various problems. The author has been contributing to this field over the last decade. The author deals with a wide range of problems confronting the engineer. Some of the topics we list:—Flow in channels, channel design, jet deflected around curved surfaces, symmetrical jets, porous and perforated walls, blockage in a slotted tunnel, thin and thick aerofoil theory, bubbles on thin aerofoils, aerofoils with spoilers, unsteady aerofoil theory, the jet flap, jets and wakes, unsteady motion of aerofoils in channels and jets, etc. This recitation does not imply the book is a library of solutions. The nature of the problems of each set is clearly described, the solutions of the problems follow, the solutions are discussed and the mathematical steps clearly set forth. The problems of the industry and the needs of the engineer are understood: the author's perspective leads the student through the mathe-

matics. The exposition will benefit a range of readers with more limited interests.

The text is well illustrated. The extensive bibliography will be useful.

G. SRI RAM.

### Interscience Tracts on Physics and Astronomy.

Nos. 8-11. (Interscience Publishers, Inc., 250, Fifth Avenue, New York-1, N.Y.), 1961. Price for each Number \$2.50 (paper bound) \$4.50 (cloth bound).

No. 8—*Introduction to the Theory of Ionized Gases*. By J. L. Delcroix. Pp. xi + 149.

No. 9—*An Introduction to Celestial Mechanics*. By Theodore E. Sterne. Pp. xi + 206.

No. 10—*General Relativity and Gravitational Waves*. By J. Weber. Pp. viii + 200.

No. 11—*Introduction to Elementary Particle Physics*. By R. E. Marshak and E. C. G. Sudershan. Pp. viii + 231.

The value of these publications, the *Interscience Tracts*, on subjects of current and growing importance, has been known by now. We had occasion to review some of the earlier numbers of this series in the pages of the Journal. The four tracts under review maintain the standard and objects of the publication and will no doubt be acquired by those who have already the previous numbers in their possession; others also should go in for the series. The cheaper, paper bound volumes will enable individuals to possess their own copies.

The new subject of "plasma physics" has revived interest in the theory of ionized gases. Delcroix's book on the subject stands as a complementary volume to the one by L. Spitzer on the "Physics of Fully Ionized Gases" (Tract No. 3), and treats the subject of ionized gases using the microscopic description of the state of the gas, and discusses the foundation of the hydrodynamic methods, followed by Spitzer. The English translation of the original in French has been commendably done.

Sterne's book on "Celestial Mechanics" will interest not only students of astronomy but also non-specialists who are interested in the subject or concerned with orbital problems, and problems of artificial satellites, missiles, and space travel.

In the book by Weber, which is fairly stiff reading, the author has given a good introduction to the foundations of the general relativity theory, to the Riemannian geometry and tensor calculus. About a third of the book deals with the theoretical and experimental aspects of gravitational waves. The last chapter on selected topics in general relativity includes unified field theories, Machs' principles, Friedman's solution.

of the cosmological problem, and Hamiltonian formulation of general relativity. The photograph of young Einstein as frontispiece is one that is not usually found in many other books.

The physics of elementary particles is a subject that is attracting the attention of a number of scientists both from the experimental and theoretical points of view. The Proceedings of the Rochester Conferences on High Energy Physics (with which the authors themselves are intimately connected) are proof to the enormous researches that are going on in this field. The present tract, though limited in its compass, is authoritative on the subject and forms an admirable introduction to elementary particles for non-experts in theoretical high energy physics.

**The Organic Chemistry of Boron.** By W. Gerrard. (Academic Press, London and New York; India: Asia Publishing House, Bombay-1), 1961. Pp. x + 308. Price 55 sh.

Even though organic compounds have been known for over a century, they have attracted wide attention only in recent years, mainly because of their potential applications in such wide and varied fields as neutron absorption, high temperature resistant polymers and high flame speed fuels. During the last 3-4 years phenomenal progress has been made in this field because of the discovery of new and economic methods of producing the basic compounds such as diborane and boron halides.

There is not a single comprehensive book on organoboron compounds even though innumerable papers and several review articles are scattered in the literature. The author should be congratulated on bringing out this monograph, condensing all available data into 300 pages. In addition to describing the reactions and techniques used in the organic chemistry of boron, the author has also given their actual, suggested and potential industrial applications and has successfully paved the way to a better understanding of this branch of chemistry.

The book is well written and the following chapters deserve special mention: Boron trichloride-alcohol, phenol, ether systems; boron chemistry of carboxylic acids, esters and carbonyl compounds; the attachment of one, two and three hydrocarbon groups to boron; special tetravalent boron compounds; oxidative fission of carbon-boron bonds; hydrido compounds of boron; Boron-nitrogen compounds; boron-phosphorus compounds; infra-red spectra of boron compounds. Cross references to material of supplemental interest and all references cited in the book are given at the end. Inclusion of

a classified appendix, detailing references based on type and applications of organoboron compounds is a special feature of the book.

Though the author has tried to present a balanced view on the whole, one would have expected him to devote some more attention to the organoborons (Chapter 7) specially in view of the tremendous progress made in this field as well as their innumerable synthetic applications discovered in the last 2-3 years.

This monograph should prove highly useful to organic chemists in general and specially to those interested in the various aspects of organic chemistry of boron and as such it deserves a place in all libraries.

B. C. SUBBA RAO.

**Protein Biosynthesis.** Edited by R. J. C. Harris. (Academic Press, New York), 1961. Pp. 409. Price 95 sh.

This volume gives an account of proceedings of a symposium on "Protein biosynthesis" held at Wassenar between 29th August and 21st September 1960 under the auspices of UNESCO and the Council for International Organisations of Medical Sciences. It contains 28 contributions by leading workers on the subject from different parts of the world. During the last few years great advances in our knowledge of biosynthesis of proteins have been made by several groups of workers. This information is scattered over numerous papers in many journals. This symposium has helped to bring together workers in the field, and has enabled them to have mutual exchange of ideas in a rapidly advancing field. Some of the important contributions at the symposium are "The mechanism of glutathione synthesis" by F. Lipmann and H. M. Bates; "The synthesis of serum albumin by the microsome fraction of the liver" by P. N. Campbell; "Protein synthesis in isolated Mitochondria: its relationship to oxidative phosphorylation and its bearing upon theories of mitochondrial replication" by D. B. Roodyn, P. J. Reis and T. S. Work; "Amino-acid transport into cell nucleus and reactions governing nuclear protein synthesis" by V. G. Allfrey and A. E. Mirsky; "Incorporation of labelled amino-acids into protein by ribonucleoprotein particles from rat liver microsomes" by T. Hultin, and A. von der Decken; "Ribonucleoprotein particles as 'Templates' for protein synthesis" by P. Siekevitz; "Protein synthesis in muscle, with emphasis on myofibrils" by T. Winnick, and R. E. Winnick; 'Linear growth of the polypeptide chain' by H. F. Freksa. The concluding chapter by H. Chantrenne contains a critical summary of the

important topics discussed. This publication will be widely welcomed by biochemists and by workers in the field of protein biosynthesis.

M. SWAMINATHAN.

**The Bacteria: A Treatise on Structure and Function, Vol. II. Metabolism.** Edited by I. C. Gunsalus and R. Y. Stanier. (Academic Press, New York and London), 1961. Pp. xv + 572. Price \$ 15.00.

The present volume is the second of the five in the series on "The Bacteria" and provides a comprehensive survey of their "Metabolism". Like its predecessor, it succeeds well in its avowed purpose to serve as a "source book" on the subject.

The book has eleven chapters dealing with Energy-yielding metabolism; Fermentation of carbohydrates and related compounds; Fermentations of nitrogenous organic compounds; Cyclic mechanisms of terminal oxidation; The dissimilation of high molecular weight substances; Microbial electron transport mechanisms; Cytochrome systems in aerobic and in anaerobic electron transport; Cytochrome-independent electron transport enzymes; Bacterial photosynthesis; and, Bacterial luminescence. The material presented in each of the chapters—contributed by well-known investigators in the fields—is uniformly informative and interesting and provides a good balance between general review, discussion of fresh grounds broken, and development of new concepts in the different areas of bacterial metabolism. There are useful references at the end of each chapter, and also an author index and a subject index at the end of the book.

The book is compact and well proportioned, and provides objective and well-knit knowledge of the subject. The editors and the authors are to be congratulated for the overall thoroughness with which so many areas of the subject have been covered.

J. V. B.

**Illustrated Genera of Imperfect Fungi, Second Edition.** By H. L. Barnett. (Burgess Publishing Company, Minneapolis, Minnesota), 1960. Pp. i-iii + 225. Price \$ 4.50.

The first edition of Barnett's book has been used widely and this second edition has been considerably enlarged to include a larger number of genera and also line drawings which are a distinct improvement on those of the first edition. The fungi imperfecti, once thought to be a temporary repository for those fungi lacking a sexual phase, have now come to stay and

to the plant pathologist and the applied mycologist, the fungi of this group are of unusual significance. Naturally, during the past few years much attention has been paid to the taxonomy of this group and several important taxonomic studies have appeared. Generic concepts have changed. New genera have been established; some old genera have been discarded. The classification of the imperfect fungi is in the melting pot. There is as yet no work which brings within its compass all this newer knowledge which is now available and, although in the garb of a manual, Barnett's valiant attempt in this direction, will therefore be welcomed. In this new edition Dr. Barnett has tried to present a general picture of the salient features of several (462) genera which are classified in five groups: Conidial Phycomycetes, Moniliales, Sphaeropsidales, Melanconiales and Mycelia sterilia. For each genus, a brief description is given together with citations to useful literature and line drawings which are for the most part redrawn by the author himself from different sources. A Key to the genera precedes the text, the general pattern of the Key corresponding to that of Saccardo. The list of references to literature is excellent and there is no doubt reference to these will provide the reader with a wealth of information which could not possibly have been included in the manual. There is a useful alphabetical index to the genera with an indication of the genus number cited in the text.

Considering the difficulties of summarising our present knowledge on this group for the purpose of providing a useful manual for the identification of these fungi, Dr. Barnett is to be congratulated for this new edition. There are some blemishes, however, and it is hoped that the third edition of this work will be free from these. For instance, it is now generally agreed that we may discard some genera such as the following: *Acrostalagmus* Corda (= *Verticillium*), *Acrotheca* Fuck. (= *Ramularia*), *Bisporomyces* v. Beyma (= *Chloridium*), *Cerebella* Ces. (= *Epicoccum*), *Exosporium* Link ex Wallr. (= *Helminthosporium*), *Ghiocladopsis* Saksena (= *Cylindrocarpon*), *Hormodendrum* Bon. (= *Cladosporium*), *Pachybasium* Sacc. (= *Trichoderma*), *Phragmocephala* Mason and Hughes (= *Endophragmia*), *Spondylocadium* Mart. (= *Stachylidium*), *Sirodesmium* de Not. (= *Coniosporium*), *Sporocybe* Fr. (= *Periconia*). Most of the papers in which these proposals of synonymy have appeared are quoted by the author and yet the nomenclature has not been revised. *Zygodesmus* Corda is a *nomen dubium* fide Rogers, *Scolecotrichum* Kunze is a *nomen*

*confusum* fide Hughes and there is no such thing as *Monotospora* Sacc., but they are still used by the author. Descriptions of some of the genera could have been more precise. Thus, there is no mention of maturing of conidia from apex backwards in the conidial chains of *Periconia* (p. 92) and of *Dwayamala* (p. 102). That *Echinobotryum* Corda (p. 94) is a stage of *Stysanus* (= *Cephalotrichum*) is not mentioned. No phialospore stage is mentioned for *Acremoniella* (p. 94). In a few cases, the illustrations are not sufficiently typical: e.g., those of *Pullularia* (Fig. 148), *Camposporium* (Fig. 225). Many generic names are misspelt and I have no doubt careful proof-reading would have eliminated most of these.

Notwithstanding these shortcomings, this manual ranks as the only one which presents in an illustrated form much of the salient information now found scattered in various journals and monographs. It will be found very useful by everyone interested in identifying or studying imperfect fungi. The price is reasonable and should make it available even to individuals. The classical mycology texts and old as well as recent monographs should always be consulted mainly to supplement the information presented by Barnett in his manual.

C. V. SUBRAMANIAN.

**Research Techniques in Use at the Grassland Research Institute, Hurley.** By Members of the Institute Staff. (Published in 1961, by the Commonwealth Agricultural Bureaux, Farnham Royal, Bucks, England.) Pp. 167. Price 40 sh.

This book published as Bulletin 45 of the Commonwealth Bureau of Pastures and Field Crops gives an integrated account of the techniques used in different aspects of pasture research at Hurley. The techniques used in the design of experiments, in herbage plant and animal investigations and in plant-soil studies are described in Parts I, II, III and IV of the Bulletin respectively. Those used in extension trials of promising results are given in Part V and the methods of use of special laboratory equipment in Part VI. Many of the techniques are illustrated by suitable figures and plates. The Bulletin provides the names of contributors in Appendix I, the addresses of manufacturers of equipment in use at the Institute in Appendix II, a conversion table in Appendix III, a bibliography and a glossary at the end. A volume like this based on contributions from a team of workers actively engaged in research and having all these features is certain to be

valuable to research workers in grassland and allied fields. The techniques will be found useful by workers in Grassland Research Institute that is contemplated to be established in India in the near future, of course with modifications to suit our conditions and requirements. In pasture research in this country where majority of people are vegetarians the stress will necessarily be on the improvement of dairy cattle for their milk and not so much on beef cattle and sheep as is the case in a country like England.

M. B. R.

**Encyclopedia of Chemical Technology.** Edited by Raymon E. Kirk and Donald F. Othmer, Second Supplement Volume Editor: Anthony Standen. (Interscience Encyclopedia, Inc., New York), 1960. Pp. xv + 970. Price \$25.00.

As is well known this Encyclopedia of 15 volumes published between 1947 and 1956 contain a comprehensive summary of industrial knowledge on materials, methods, processes, and equipment for the chemist and the chemical engineer. There are more than 1,000 authoritative articles written by experts drawn from industry and research institutions.

The publishers bring out supplementary volumes from time-to-time to make the Encyclopedia up-to-date by including latest developments in the subjects concerned. The first supplement volume containing 51 articles was published in 1957.

The Second Supplement volume under review contains 58 articles dealing with subjects in which recent developments have been particularly noteworthy. These include Boron compounds, Cryogenics, Fuel cells, Gas Chromatography, Nonionic surfactants, Polymethylbenzenes, Ultra-violet absorbers and unsaturated polyester resins. The volume contains, besides its own index, an integrated list of the articles in the first 15 volumes and the two supplements.

**Name Reactions in Organic Chemistry** (2nd Edition). By A. R. Surrey. (Academic Press, New York; India: Asia Publishing House, Bombay-1), 1961. Pp. x + 278. Price \$8.00.

Those who have read the first edition of this book would, no doubt, have been impressed by its usefulness as a reliable guide in organic laboratories. These "name reactions" constitute a considerable portion of the tools available to the organic chemist, and since their discovery by the pioneers concerned, many of these reactions have found greater utility in their modified and improved forms.

The demand for a second edition has been availed of by the author to make extensive revision, add new material, and bring the whole book more up-to-date.

Nearly 130 reactions of fundamental importance and wide applications have been included. Each reaction is described with clarity and conciseness with the necessary formulæ. Its limitations and scope are also indicated. The brief biography of the discoverer at the beginning of each article adds historical and human interest to the study. References to important literature on the subject cited at the end of each article will prove very useful.

**The Harvey Lectures—Series 55, 1959-60.** (Academic Press, New York; India: Asia Publishing House, Bombay-1), 1961. Pp. xiv + 257. Price \$ 8.00.

These lectures serve the useful purpose of reviewing current problems of biological, biochemical and physiological interest. In "Quantitative growth of mammalian cells" advanced methodology of culturing mammalian cells has been applied to the study of the chromosomal behaviour of human cells of both normal and cancerous origin and the role of fetuin, a glycoprotein in the growth of single  $S_3$  cells has been discussed. "Inside Nucleic acids" tries to dissect out the structure of Polynucleotides, RNA and DNA. 'Fœtal hormones in prenatal development' analyses the influence of Adrenocortical, pituitary and placental hormones on liver glycogen. The lectures dealing with the current status of our information about iron metabolism, recent concepts pertaining to renal mechanisms involved for potassium excretion, the role of  $N_2$  gas in various biological processes, the complexity of the processes involved even in reputedly simple vital mechanisms as wound repair, and the neurotransmission in the adrenergic nervous system, provide a wealth of information and at the same time also depict the lacunæ in our knowledge of many fundamental life processes.

M. SIRSI.

**A First Course in Mathematical Statistics.** By C. E. Weatherburn. (Cambridge University Press, London, N.W. 1), 1961. Pp. xv + 277. Price 18 sh. 6 d.

The reprinting of this popular text-book on Mathematical Statistics by Prof. Weatherburn will be welcomed by all students of statistics. The aim of the book is to provide the mathematical foundations of statistics, to prove the

formulæ and the validity of the methods employed in the interpretation of statistical data. Being based on a course of lectures which the author has given for several years, the treatment is clear and brings out the essential unity of the subject and its applications to different disciplines like biology, agriculture, economics, etc. The comparatively inexpensive paper back edition should enable every student of statistics to own a copy of this fundamental text-book on the subject.

#### Books Received

**Nuclear Power Today and Tomorrow.** By K. Jay. (Methuen & Co. Ltd., 36, Essex Street, London W.C. 2), 1961. Pp. 270. Price 25 sh.

**Plasmas and Controlled Fusion.** By D. J. Rose and M. Clark Jr. (The M.I.T. Press, Mass.; and John Wiley & Sons, New York-16), 1961. Pp. xiv + 493. Price \$ 10.75.

**A History of Astronomy.** By A. Pannekoek. (George Allen & Unwin Ltd., Ruskin House, London W.C. 1), 1961. Pp. 521. Price 65 sh.

**Roger Joseph Boscovich: Studies of His Life and Work.** Edited by L. Law Whyte. (George Allen & Unwin Ltd., London W.C. 1), 1961. Pp. 230. Price 32 sh.

**A History of Chemistry (Vol. II).** By J. R. Partington. (Macmillan & Co. Ltd., St. Martin's Street, London W.C. 2), 1961. Pp. xxiv + 795. Price £ 5, 5 sh.

**Organic Chemistry Today.** By F. W. Gibbs. (Penguin Books Ltd., Harmondsworth, Middlesex), 1961. Pp. x + 294. Price 7 sh. 6 d.

**Numerical Analysis (2nd Edn.).** By Z. Kopal. Chapman & Hall, 37, Essex Street, London W.C. 2), 1961. Pp. xvi + 594. Price 70 sh.

**A Guide to the Metric System.** By V. V. L. Rao. (Asia Publishing House, Bombay-1), 1961. Pp. xi + 64. Price Rs. 6.

**Proceedings of Symposium on Proteins.** (The Central Food Tech. Res. Institute, Mysore-2), 1961. Pp. xx + 454. Price Rs. 20.

**Selected Topics from Organic Chemistry.** By Karve, Advani and Bhagwat. (Dastane Ramachandra & Co., P.B. No. 535, Poona-2), 1961. Pp. xiii + 479. Price Rs. 12-50.

**Cosmology.** By H. Bondi. (Cambridge University Press, London N.W. 1), 1961. Pp. 182. Price 15 sh.

**Coconut Cultivation.** By C. M. John. (The Indian Central Coconut Committee, Ernakulam, S. India), 1961. Pp. 45. Price Rs. 2.

**Radical Polymerization.** By J. C. Bevington, (Academic Press, London S.W. 1), 1961, Pp. viii + 185. Price 40 sh.

## SCIENCE NOTES AND NEWS

### School in Theoretical Chemistry

A School in Theoretical Chemistry will be held between the 2-14 of April 1962 at the Department of Physical Chemistry, The Hebrew University, Jerusalem, Israel—under the direction of Professor C. A. Coulson, F.R.S., Oxford University and Dr. L. E. Orgel, Cambridge University and with the participation of Professor R. Pauncz and Dr. J. Jortner. A knowledge of theoretical chemistry at an intermediate level is required of those wishing to participate. Those interested are requested to write immediately to the Department of Physical Chemistry.

### Conference on Hydraulics and Fluid Mechanics

The University of Western Australia, Faculty of Engineering, is to hold a Conference on Hydraulics and Fluid Mechanics in Perth, December 6th-13th, 1962 (incl.).

Contributions are invited from the fields of aeronautical, civil and mechanical engineering, applied mathematics, chemistry, physics, agriculture, biology, medicine, zoology and others in which fluid flow presents problems of measurement, instrumentation, basic understanding or analysis.

For copies of the First Circular giving full information please write to the Conference convener, School of Engineering, University of Western Australia, Nedlands, Western Australia.

### Symposium on Plant and Animal Viruses

A two-day symposium on recent advances in Plant and Animal Viruses was held at Cuttack on December 31, 1961 and January 1, 1962. The symposium was inaugurated by Dr. P. Parija, Vice-Chancellor of the Utkal University. Prof. T. S. Sadasivan, Director of the University Botany Laboratory, Madras, was the Convener. A number of scientists actively engaged in this field of research from the various universities and research institutes in the country took part in the symposium.

### Lady Tata Memorial Trust Scholarships for 1962-63

The Trustees of the Lady Tata Memorial Trust invite applications from Medical or Science graduates of Indian nationality for six scholarships of Rs. 250 each per month for the year 1962-63 tenable in India for whole-time

research work on a subject bearing on the alleviation of human suffering from disease. Applications, which should reach by March 15, 1962, must conform to prescribed instructions which can be obtained from the Secretary, Lady Tata Memorial Trust, Bombay House, Bruce Street, Fort, Bombay-1.

### "Impact"

The latest issue of *Impact*, Vol. XI (1961), No. 3, the quarterly published by the UNESCO, Place De Fontenoy, Paris 7<sup>e</sup> (France), contains the following articles: Mankind and Outer Space; The Decisive Step in the Conquest of Cosmic Space by E. K. Fedorov; General Problems Confronting Computing Centres by R. Courant; Fish Technology and the Community by G. H. O. Burgess; and Science and the Road Traffic Problem by G. Charlesworth.

The first article describes the orbital flight of the first Soviet astronaut Gagarin on April 12, 1961, and of Shepard the first American astronaut on May 5, 1961.

The last article describes the results of research in Great Britain on such traffic problems as the movement of traffic, its economics, roads lay-out, traffic control, road accidents, etc.

### The Root of *Oxalis latifolia* HBK.

Messrs J. P. Sinha and U. N. Jha, Department of Botany, Ranchi University, Ranchi, write: The species of *Oxalis latifolia* HBK. grows luxuriantly in Ranchi usually in damp habitats after summer when monsoon breaks. The characteristic feature of the species growing at this place is the presence of either one main or rarely two or three distinct succulent roots which are found in the form of conical or fusiform as has been reported for the species of *Oxalis tetraphylla*.

### Rearing of More than One Generation of Univoltine Silkworms

With reference to the article on "Rearing of more than one Generation of Univoltine Eggs" by A. S. Atwal and A. N. Verma, published in *Current Science*, 1961, 30, 435, Sri. N. K. Gururajan, Principal, All-India Sericultural Training Institute, Mysore-4, writes: The procedure of artificially breaking the diapause in the eggs of silkworms (*Bombyx mori*) of uni and bivolt-

tine origin by treating them in hydrochloric acid of 1.075 sp. gr. at 46° C. for 5 minutes has been in vogue both in foreign countries and also in India for more than two decades and it is a matter of routine to get many brooded varieties from uni and bivoltines, both in the univoltine regions of Kashmir, Punjab and Uttar Pradesh and in multivoltine areas of Mysore and Madras. This information has been published already in several reports. Some of the Government Farms in Kashmir and Uttar Pradesh have been adopting this method of breaking the dormancy in univoltine and bivoltine races for commercial rearing. It may be noted for information, to break the diapause in silkworm eggs even cold hydrochloric acid of 1.1 sp. gr. is used extensively at room temperature with good rearing results.

#### Field Ionization Technique in Mass Spectrometry

At the Fourth International Symposium on Mass Spectrometry held at Rhodes House, Oxford University, on September 11-15, 1961 a new instrumental technique was outlined by Becky. In this, the conventional ion source was replaced by a field ionization source in which the molecules are subjected to an intense field of the order of  $10^8$  V/cm. The effect of this is to modify the potential wall of the molecule in such a way that an electron can escape in the ground state. As a result the molecule does not acquire any excitation and does not undergo fragmentation. The mass spectra resulting from field ionization are thus very simple and the molecule ion predominates. This 'weak' method of ionization makes it possible to study molecules which would otherwise decompose in a conventional source and permits the examination of molecular associations. Polymeric ions of water, ethanol and propanol have been examined in this way.

#### Radioactivity in Rainfall during September 1961 following the Russian Nuclear Tests

Results of experiments on radioactivity of rain-water reported from the Research Laboratory of the Associated Electrical Industries, Berks, show the activity to be distinctly higher after September 2, 1961 that is, following the commencement of the Russian nuclear tests, than in previous months.

Analyses were made for the total  $\beta$ -activity per litre of the rain-water sample collected, as well as per gm. of the residue of the sample after evaporation. Maximum activity was

shown by the sample collected on September 13-14. This was 8050  $\mu\text{mc.}/\text{gm.}$  for the residue, and 48.4  $\mu\text{mc.}/\text{l.}$  for the rain-water. Compared to this the corresponding figures for previous months were 160  $\mu\text{mc.}/\text{gm.}$  and 5.1  $\mu\text{mc.}/\text{l.}$

That the excess activity was due to fission products was confirmed by specific isotopic analysis for iodine-131. This activity in rain-water was found to be 9.8  $\mu\text{mc.}/\text{l.}$  for sample collected on September 13-14, 95.5  $\mu\text{mc.}/\text{l.}$  for those collected on September 14-18, and 14.2  $\mu\text{mc.}/\text{l.}$  for sample of September 27.—(*Nature*, 1961, 192, 443.)

#### Automation Applied to X-Ray Crystallography

Research into the atomic structure of crystals will be significantly accelerated by a new X-ray diffraction technique which is almost entirely automatic. The new technique called Pexrad (Programmed Electronic X-ray Automatic Diffractometer) has been developed by Bell Telephone Laboratories, and is similar in principle to their automatic neutron diffractometers which are currently being used in many nuclear reactor laboratories.

In the Pexrad method information such as crystal lattice constants, the wavelength of the X-ray beam, and instrumental constants are fed to the computer on punched cards, along with a compiling programme. The computer generates a magnetic tape from which a punched paper tape is made. Fed into Pexrad, it controls the motors which rotate the crystal and receiving counter into position, and then causes an X-ray beam of prescribed wavelength to irradiate the crystal for a precise length of time. The intensity of the beam which is diffracted by the crystal is measured and recorded on punched tape. The crystal is automatically rotated to the next position and the process is repeated.

The punched tape from Pexrad containing the readings is converted to a magnetic tape and is fed back into the digital computer. The computer integrates the intensities, corrects for absorption, rotation, Lorentz and polarization factors, and prints out the corrected data from which the location of the individual atoms can be calculated.

With Pexrad, a crystal can be oriented with a hundredth-of-a-degree accuracy; therefore, it can be used to study almost any non-biological crystal. The method could be extended to protein crystals, which need about one-thousandth-of-a-degree accuracy in crystal positioning.—(*Jour. Frank. Inst.*, 1961, 272, 343.)



### High-Temperature Heat Capacity of Diamond

Recent measurements at the National Bureau of Standards have resulted in improved values for the high-temperature heat capacity of diamond. These data, obtained over the range of 323 to 1,073° K. and accurate to within 0.5% over most of the range, join smoothly with other values down to the temperature of liquid hydrogen. An experimental basis is thus provided for the verification of theoretical treatments of diamond lattice dynamics over a wide range of temperatures. Precautions were taken to prevent oxidation of the diamonds in the present work, and the data obtained are believed to be more reliable than previous results (1926) in the temperature range employed.

Diamond-type crystals are of considerable interest for several reasons. Because the "low temperature" behaviour of the diamond extends to nearly 1,000° K., useful data can be obtained with both low- and high-temperature calorimeters. Also, as the interatomic forces in the diamond lattice are largely covalent, continued investigation should provide further information concerning the directional characteristics of these bonds. Furthermore, silicon and germanium, materials of increasing scientific and industrial importance, possess crystal structures similar to the diamond.

The usual procedure for solving problems concerning diamond lattice dynamics is to propose a model of the interatomic forces and, employing the elastic constants and first-order Raman frequency shift, to solve a series of equations leading to a calculated value of heat capacity. In order to check the results of such a treatment, reliable values of measured heat capacity must be available.—(*National Bureau of Standards News*.)

### Seminar on Aeronautical Sciences

The above Seminar was organized by the National Aeronautical Laboratory, Bangalore, under the auspices of the Council of Scientific and Industrial Research and was held from 27th November to 2nd December 1961. The Seminar was inaugurated by the Governor of Mysore and presided over by Prof. M. S. Thacker, Director-General of the Council of Scientific and Industrial Research.

Over 250 delegates including 20 delegates from such foreign countries as Australia, France, Holland, Japan, United Kingdom and U.S.A., attended the Seminar. The delegates were wel-

comed by Dr. P. Nilakantan, Director of the National Aeronautical Laboratory. The technical sessions of the Seminar covered several fields of aeronautical interest.

The session on Aviation Meteorology was presided over by Dr. P. R. Krishna Rao, Director-General of Observatories, India. The main topic discussed was wind structure at high altitudes and its influence on air navigation. The session on Aircraft Structures and Materials was presided over by Dr. V. M. Ghatage, Deputy General Manager, Hindustan Aircraft Ltd., Bangalore. Among the topics discussed were creep, fatigue and thermal effects. Prof. S. Dhawan, Indian Institute of Science, Bangalore and Prof. R. Kawamura, Aeronautical Research Institute, University of Tokyo, Japan, presided over the two sessions on Aerodynamics and papers on formation and stability of shock waves, hypersonic aerodynamics and approximation in transonic flow were presented. The highlights of the session were major surveys on aerodynamic noise by Prof. M. J. Lighthill, Director, Royal Aircraft Establishment, U.K. and Mr. Arthur A. Regier, National Aeronautics and Space Administration, U.S.A. In the two sessions on Fluid Mechanics presided over respectively by Prof. Lighthill and Prof. P. L. Bhatnagar, Indian Institute of Science, Bangalore, papers on flow in bent pipes, transition and nature of turbulence, boundary layer problems in hypersonic flows and models for plasma oscillations were discussed. Dr. Frank L. Wattendorf, Director, Advisory Group for Aeronautical Research and Development (NATO), France, presided over the session on Wind Tunnel Design and Testing, Aircraft Propulsion and Flight Research. Papers were presented on wind tunnel design problems, particularly at high subsonic and transonic speeds. Particular interest was shown in a report by Mr. F. W. Hooton of the Aeronautical Research Laboratories, Australia, on the formation of a flight research group in his Laboratories. Prof. S. V. C. Aiyar, Indian Institute of Science, Bangalore, presided over the session on Aviation Electronics and among the papers presented the one by Mr. W. A. Johnson on Recent Researches done at Royal Aircraft Establishment in the field of aviation electronics and that by Mr. L. R. Lucassen, National Aero- and Astronautical Research Institute, Holland, on an instantaneous method for measuring antennae radiation pattern of the Fokker-27 in flight, evoked considerable interest.

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# THE DIATOMS\*

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**D**IATOMS represent a clearly demarcated group of unicellular plants, Bacillariophyceae, which are characterized by a yellow-green pigmentation, common in Chrysophyta (see however Phillips Dales<sup>28</sup>). The living portion or the protoplast is clothed by a silicate wall which is in two pieces, fitted like the two halves of a soap-box. These silicate walls, frustules, are very well preserved as fossils, and are found extensively as diatomaceous earth.

The frustules are characterized by exquisite patterns of ornamentation which, except in a few cases, were once thought to be areas of lesser silicification. These structures are so fine and regular that microscopists have always sought to use these markings for judging the resolving power of the objectives. Naturally the advent of the Electron Microscope inaugurated intensive studies of these organisms, the most outstanding being those of Helmcke and Krieger.<sup>16</sup> These studies have been reviewed by Desikachary<sup>6</sup> and Hendey.<sup>17</sup> Desikachary<sup>6</sup> recognizes three main and nine minor categories of structural patterns in diatom frustules. Hendey<sup>17</sup> recognizes 17 types and illustrates them with three dimensional models. It would not be possible to deal with these types in any great detail here. While it is true that an overall idea of major types of structural patterns of the areolae, punctae and striae is now available yet the work of Cassie and Bertaud<sup>2</sup> has shown that our present knowledge is not complete and a final analysis must await studies of a larger number of genera and species than has hitherto been done.

Diatom frustules, being made of silica, were thought to be non-porous and it became difficult to explain how absorption of nutrients from the environment could take place through such a non-porous wall.<sup>9,21</sup> The one major contribution made by the electron microscopic studies is the knowledge that these frustules have regularly arranged pores and as such they are 'open' to exchange of nutrients. The techniques presently used in studying the frustules preclude any decision whether there is, or not, a proteinaceous or protoplasmic membrane as such

separating the protoplast from the surrounding medium.

Electron microscopic studies of cellular contents of the diatoms have not progressed to the same extent as they have in other algae. The structure of the chromatophore or chloroplast in other algae is considered to be lamellar as against the granular construction seen in the higher plants. Types of structures intermediate between the two have been reported by Chardard and Rouillier<sup>3</sup> and Butterfasz.<sup>1</sup> The chromatophores of diatoms are yet to be studied in any great detail. One of the obstacles to this study is the silicate frustule which prevents ultra thin sectioning of the chromatophore with the wall. The only accounts of the chromatophore structure show that these are lamellar.<sup>35</sup> Hope of further research in this field is held out by the work of Daniels and Hayes<sup>5</sup> who have sectioned intact diatoms (*Cocconeis* sp.?) remaining attached to other algae. The ultrastructure of the pyrenoid in the diatoms has not been studied so far.

There is one other aspect which is currently of interest to the algologist. The chemical nature of the silica contained in these frustules is yet to be fully understood. In the past these frustules have been considered to be of an amorphous nature in living and recent fossil material whereas in geologically older material some evidence of crystallinity was observed (Rogall<sup>31</sup>; Geissler<sup>10</sup>). Swineford and Franks<sup>34</sup> have shown that fossil diatomaceous marl gave a diffraction pattern distinctly different from the disordered low cristobolite diagrams given by a number of forms of opal, to which it was once thought to be related. Desikachary and Dweltz<sup>7-8</sup> and Mehta *et al.*<sup>27</sup> have given evidence to show that the major constituent of the frustule appeared to be  $\alpha$ -quartz.

Rogall<sup>31</sup> and others have earlier reported the presence of iron or aluminium oxides in many plankton samples. Desikachary<sup>6</sup> mentions the presence of Al in *Desmogonium guayanense*. Mehta *et al.*<sup>27</sup> have reported it in *Diatoma hiemale* v. *mesodon*. Presence of iron as  $\text{Fe}_2\text{O}_3$  was shown by Desikachary and Dweltz<sup>8</sup> and by Mehta *et al.*<sup>27</sup> Lewin<sup>24</sup> who has been working very intensively on the silicon metabolism in Diatoms has shown that iron is present in the frustules and that this is essentially responsible for making silica more insoluble, since on

\* Based on a talk delivered at the XXVII Annual Meeting of the Indian Academy of Sciences held at Mysore in December 1961.

treating with EDTA, and thus removing a cationic inorganic factor, there is a greater dissolution of the silica from the frustule.

Aluminium is effective in combining with silica and thereby reducing its solubility and retarding the rate of dissolution. The hydrated  $Al^{3+}$  cation presumably reacts with free hydroxyl groups at the silica surface. Based on Iler's work<sup>18</sup> on polysilicic acid Lewin<sup>24</sup> suggests that though the polysilicic acid of diatom walls is not in colloidal solution, similar chemical combinations would presumably occur at the surface in the presence of metal ions. The evidence indicates that "combination with silicic acid does not occur below the pH at which metal hydroxide would be formed (either as a sol or as a precipitate) on prolonged standing". Iler<sup>18</sup> suggested that the reaction could be considered as a combination between a Silanol group ( $SiOH$ ) and a basic metal ion [such as  $Fe(OH)^{2+}$ ]. According to Lewin<sup>24</sup> it is possible that if silica valves while part of the intact living cell, could be initially protected against solution by some other biophysical or biochemical means, there would be time later for colloidal ferric and aluminium hydroxides to be passively adsorbed and accumulated on the new surfaces and the system to be thereby stabilized. That ferric hydroxide could be adsorbed on diatom surfaces is known by the work of Harvey,<sup>14</sup> Goldberg,<sup>13</sup> Geissler<sup>10</sup> and Ives.<sup>19</sup>

Lewin<sup>24</sup> says that we must now recognise the importance of adsorbed cations such as Fe, Al and perhaps organic protective coatings (see also Cooper<sup>1</sup>), in depressing the rate of dissolution of diatom frustules. That  $Fe_2O_3$  is probably a constituent of the frustule is now certain<sup>8</sup> and that there is a pectin associated with the frustule seems to be generally recognised. Desikachary and Dweltz<sup>8</sup> have mentioned that there is some organic substance connected with the frustules and it is only the removal of this that makes the frustules give a crystalline diffraction pattern. This organic material must be external and different from the basic pectic material which forms the foundation for the deposition of the silicate material.

Frustules show a great amount of solubility when broken rather than as a whole as then the ground matrix of pectic material is open for chemical action, thus releasing the silicate material for solution—a process probably similar to that occurring in nature as well as in the gastric channels of animals which feed on the diatoms (Jorgensen<sup>22</sup>; Subrahmanyam<sup>33</sup>). Iler<sup>18</sup> has suggested that Mg, Fe, Al, or other polyvalent cations, in natural waters, may produce

a coating of insoluble silicates and thus prevent the enclosed silica from dissolving or alternatively organic complexes on the surface of the silica may prevent dissolution. Mehta *et al.*<sup>27</sup> suggest that Al and Mg may be present as parts of some complex aluminium silicate minerals where magnesium replaced aluminium. In our work while we did meet with a few unaccountable lines in the diffraction pictures, it was not possible to correlate them with any known silicates or oxides of aluminium.

This naturally leads us to one other aspect: Cell division and frustule formation. During cell division the two valves of the parent become the epitheca of the two daughter cells and two new hypotheca are found and thus theoretically there is a progressive diminution in size of the diatoms. This gradual reduction is attributed to the peculiar mode of division and also to the rigidity of the valve structure. But instances have been known where no such reduction in size has been noted.<sup>11,36</sup> The exact adjustment that takes place during cell division is not known. It is the mantle portion of the valve that is often held responsible. Lewin<sup>23</sup> has given an excellent electron micrograph of the valve mantle in *Navicula pelliculosa* which shows the variation in the thickness of the silica valve in the mantle as against valve face probably accounting for the flexible nature of the valve thus facilitating a readjustment of the size during cell division.

Are the frustules formed endogenously? That silicification of the wall probably occurs all round the basic pectic membrane leads one to conclude that the frustule is probably formed endogenously. But direct confirmation is yet to be got by cytological work using fluorescent vital dyes. In an ordinary cell division the hypotheca of the daughter cells are formed in the middle between the protoplasts. A significant stage is, however, seen in auxospore formation. The auxospore formed from the zygote enlarges and forms the first wall, the perizonium. This wall appears to be pectic in nature and does not have the markings of the adult valve. The true silicate valve is formed inside the perizonium and thus it appears to be endogenous. The mode of formation of the valve in the normal cell division is yet to be studied (see however Helmcke<sup>15</sup>). An endogenous formation of the frustule would leave during the final stages of the contraction or withdrawal of the external cytoplasm a trace of cytoplasm as an organic skin. Evidence for this is still to be sought in future work. Of particular interest here are

the recent observations of Manton and others<sup>25,26</sup> on marine flagellate. Manton and Parke<sup>25</sup> have observed this in the green flagellate, *Micromonas*. Manton and Leedale<sup>26</sup> have very clearly observed that in *Paraphysomonas* the scales arise from vesicles within the cell and not directly from the external body membrane. The diatoms are different from these flagellates which have an outer armament of scales in having a capsule like frustule (cf. *Rhizosolenia*). All the same as Manton and Leedale have correctly stressed their findings are of fundamental importance among scale-bearing micro-organisms in general.

Long preservation of diatom frustules also leads to a removal of the factor making the frustule insoluble. Under such circumstances the factors that might control the rate are the pH of the medium and the tenacity of the bond between the pectic membrane and silicate. Ordinarily the presence of such conditions would make the occurrence of diatomaceous deposits impossible unless it be that there are other compensating factors. There thus seems to be some justification to suggest that there may be certain processes in nature which take place once the silicate is exposed. Iler's observation that certain complex silicates get adhered to the frustule is here valuable. The diatom silica would thus become nearly insoluble. It would appear that these diatoms deposited extensively at the bottom of aquatic situations are capable of having further increase in the silicate portion, however, insignificant this growth may be. This growth is purely an inorganic process. Similar inorganic growth in crystalline organic derivatives has been shown in the case of collagen by Ramachandran and Ambady<sup>29</sup> and Ramachandran and Santanam.<sup>30,32</sup> The thickness of fossil diatoms, and consequently of the deposits, may not merely be the basic thickness of the once live diatom but may also represent the result of subsequent smaller or greater adhesion, the rate depending on the characteristics of the environment of the particular deposition.

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## FOOT ROT DISEASE IN WHEAT\*

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**F**OOT ROT of wheat caused by *Bipolaris sorokiniana* (= *Helminthosporium sativum*) is widespread and is known to cause losses to the wheat crop in various parts of India. Work is in progress in this laboratory on many aspects of the foot rot problem, particularly the cause of variation in the pathogen, its behaviour in soil and its physiology in relation to the disease syndrome. I shall discuss here some of the significant results that have emerged from our work, credit for which is to be shared by my students B. L. Jain, N. G. Nair, R. N. Prasad and P. D. Tyagi.

Prasad's work (done at the I.A.R.I., Delhi) with different strains of *Bipolaris sorokiniana* and different varieties of Indian wheat showed that there were differences in virulence of the different strains. All wheat varieties tested (NP. 4, 758, 760, 797, 798, 799, 823, 824) were susceptible. The cause of variation in the fungus has been studied by Jain whose results do not support the idea of heterokaryosis being perpetuated in the different strains he has examined. This agrees with the findings of Dickinson<sup>1</sup> and of Christensen and Davies,<sup>2</sup> but not with those of Hrushovetz.<sup>3</sup>

Since the disease is soil-borne, attention has been focused on the behaviour of the fungus in the soil. Nair has elucidated the behaviour of different strains of the fungus in soils using the Cholodny slide and the straw burial techniques. His findings support the idea of previous workers that the fungus cannot grow freely in unsterilised soil, and even spore germination is prevented in unsterilised soils because of antibiosis. Survival, however, is accomplished by the ability of the fungus to colonise dead straw, although it was clear that the extent of colonisation depended on the inoculum potential of the soil. It appears difficult to classify this fungus as a root inhabitant or soil inhabitant as defined by Garrett<sup>4</sup> since colonisation of dead straw by the fungus is possible, but only when the inoculum potential is high. It appears now necessary to consider the relation of inoculum potential to colonisation in classifying any soil fungus into one or the other category. Nair has also studied the effect of various factors such as

soil moisture, pH, and soil amendments such as nitrogen, sugar, manganese, boron and zinc on the survival of the fungus in straws in soil. High levels of moisture and addition of nitrogen, manganese, boron and zinc all favoured disappearance of the fungus from the straws, and the addition of zinc at 40, 80 and 160 p.p.m. was most effective. These results are obviously significant in adopting control measures.

In regard to the disease syndrome, a distinct reduction in the development of the root system and conspicuous stunting of the wheat plants when grown in infested soil has been noticed by Prasad and indeed by other workers also. Although, in a casual study, Vanterpool<sup>5</sup> showed that culture filtrates of the fungus inhibited development of roots and shoots of wheat seedlings, no detailed work on this has been reported. More recently, Ludwig<sup>6</sup> has postulated production of a toxin by the fungus, but his assay of the toxin was based on inhibition of germination of barley seeds and what he has termed "the barley toxicity index". Prasad's work clearly showed that culture filtrates of the fungus grown in potato dextrose medium were toxic to wheat seedlings and inhibited the elongation of the roots. There was also stunting of the shoots and distinct reduction in the dry weight of the roots and shoots in the presence of the culture filtrate. The so-called toxin was found to be non-specific since root elongation was inhibited in seedlings of barley, oat, rye, maize, jowar and bajra to the same extent as in wheat. Although sap from plants grown in uninfested soil inhibited root elongation slightly, inhibition produced by sap from plants grown in infested soil was much more, which is obviously an indication of the production of a vivotoxin. In the case of the disease in barley, Ludwig<sup>6</sup> suggested that the toxin predisposes the plant to infection, and parallel experiments carried out by Prasad gave similar results; but I believe that the entire disease syndrome cannot be explained by postulating a toxin alone, since discolouration and rotting of the root system which is a major symptom of the disease is seen only when the fungus is present.

Tyagi has further investigated the effects of the culture filtrates of the fungus, undiluted and diluted up to 1/10,000, on the elongation of wheat roots using seedlings of NP 798. In repeated experiments using different strains of

\* Substance of a talk given at the Annual Meeting of the Indian Academy of Sciences at Mysore on 28th December 1961.

*B. sorokiniana* and also other species of the genus (*B. halodes*, *B. tetramera*, *B. oryzae* and *B. turcicum*), it has been observed that the undiluted culture filtrate always inhibited elongation of the root, but dilutions of 1/5 or more stimulated root elongation remarkably. In the assessment of the effect of the culture filtrates, it is extremely important to make comparisons with suitable water controls as well as medium controls; for, the culture medium which is used for growing the fungus itself inhibits root elongation to some extent. It is unfortunate that this has not been taken into account either by Ludwig<sup>6</sup> or by other investigators working on toxins of *Bipolaris* (Litzenberger,<sup>7</sup> Wheeler and Luke,<sup>8</sup> Luke and Wheeler,<sup>9</sup> Ludwig *et al.*<sup>10</sup>). It is now clear that the extent of inhibition of root elongation should be assessed in relation to root growth in the culture medium control, but assessment of stimulation in root elongation such as is seen in the case of the diluted culture filtrates should be in relation to the root growth in water controls. Further, Tyagi has shown that wheat roots responded in the same way to undiluted and diluted culture filtrates of the fungus grown in Richard's medium (synthetic), although the extent of inhibition or stimulation and its relation to the concentration of the culture filtrates varied.

It is necessary to explain the inhibition in root elongation seen at high concentrations of the culture filtrates and the stimulation seen at lower concentrations. Since no toxin can ever be stimulatory when diluted, it appears necessary to postulate production of a growth factor also. The possibility of the production of only a growth factor, but no toxin, has also been considered, since it is known that growth factors such as indole acetic acid inhibit root elongation at high concentrations, stimulate root elongation at lower (optimum) levels and again become ineffective at still higher dilutions. However, a close and critical study of the data on the extent of inhibition or stimulation of root elongation seen in the case of various concentrations of the culture filtrates in repeated trials with different strains of the fungus grown in different media suggest that both a toxin as well as a growth factor are present in the culture filtrate. Indeed, when the culture filtrate is undiluted the toxin and the growth factor would be present in optimum amounts to produce profound inhibition; when the filtrate is diluted, the concentration of the toxin as well as the growth factor would decrease and, at some levels at least, presence of the growth factor

in optimum concentrations would produce a stimulatory effect.

A more interesting observation made by Tyagi is that in the presence of the culture filtrate of the fungus grown in potato dextrose medium, either undiluted or even down to a dilution of 1/100, in water or in Hoagland's solution, the production of root-hairs in wheat roots is completely suppressed. In contrast, root-hair development was noticed both in the culture medium and water controls. No such effects of culture filtrates of any fungus on inhibition of root-hair formation as seen by us appear to have been reported by anyone before. It has been shown that root-hair formation takes place when the seedlings are removed from the culture filtrates to Hoagland's solution, but these are produced only in the new region of the root which elongates. Although no irreversible permanent effects can be claimed, it is obvious that root-hair formation may be inhibited in the presence of the metabolites of the fungus. The extent of inhibition of root-hair formation in relation to the concentration of the culture filtrate varied with the type of culture medium and other conditions, and was not always as pronounced as in the case of the potato dextrose medium. It is interesting to note that root-hair production in nature is considered by some to be an auxin response and that high concentrations of indole acetic acid may entirely suppress formation of root-hairs (Cormack<sup>11</sup>). Similarly, root-hair formation may be retarded by high concentrations of  $\alpha$ -(phenoxy)-propionic acid (Burström<sup>12</sup>).

There is some evidence indicating that the culture filtrate loses much of its toxicity when added to the soil, but not to washed sand. Nevertheless, repeated tests have shown that in the presence of the fungus in the soil, the root system is very poorly developed. Further, when seedlings grown in infested and uninfested soil are removed carefully and their root systems examined, it has been found that very little soil adheres to the root system of plants in the infested soil due to the paucity or absence of root-hairs, although this is not true of the plants grown in uninfested soil. The general reduction in root development and of root-hairs in plants grown in infested soil has obviously great physiological significance in relation to the disease.

In conclusion, it must be emphasized that the approach here has been towards an elucidation of various aspects of the problem of foot rot of wheat, particularly the series of events leading to the disease syndrome as we see it. The

field is fascinating and complex and attention has been focused on what happens in the soil to the root system of the wheat plant in the presence of the fungus and its metabolites.

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### THE PHYSIOLOGY OF CRUSTACEA\*

COMPREHENSIVE studies on the Physiology of individual groups or organisms have formed a refreshingly new avenue in the wide range of publications on biological topics which have appeared in recent years. The Academic Press formerly issued the very useful *Introduction to the Physiology of Fishes* published in 1957 and we have now before us a similarly sumptuous work in two volumes on the Physiology of Crustacea. A comprehensive account of the physiological characteristics of this large group of animals is now presented in two volumes of collected articles written by some of the most outstanding amongst the many contributors to this field and edited by Prof. T. H. Waterman.

The Crustaceans are a group of organisms of quite distinct morphological characters, forming a compact group amongst arthropods, predominantly aquatic but occupying almost every niche of biological environments. Within this morphological compactness spread over thousands of species is found an amazing range of physiological features. Whether in reactions to stimuli, relationship between the external and internal media or problems of relative growth the crustaceans pose physiological problems of absorbing interest. Their wide distribution and the comparative facility with which they can be kept and cultured have made possible their extensive use as experimental material on which many recent hypotheses have been put forward, tested and developed.

The book opens with a general review of crustacean biology by Waterman and Chace. In the next chapter Wolvekamp and Waterman review the problems of respiration which is probably the field in which the largest

number of papers have appeared on the physiology of this group. Summarising their review the authors indicate the urgent need for follow up work made in the beginning regarding respiratory transport. Haemocyanin although a well-known respiratory pigment from early times, still remains to be investigated on many aspects of metabolism. Goodwin continues in the next chapter with a critical review of the biochemistry of Crustacean respiratory pigments. The blood-chemistry is dealt with in detail by Florkin. Circulation and heart function form the subject-matter of the next paragraph by Maynard, while the vast body of information on feeding and nutrition which is largely drawn from the work on plankton crustacea are dealt with by Marshall and Orr. Crustacean vitamins, digestion and metabolism are reviewed in the two succeeding chapters written by Fisher and Vonk respectively. Osmotic and ionic regulation on which a considerable amount of work has appeared in recent years is dealt with by Robertson who is followed by Parry on the allied problem of excretion. Edney examines the question of terrestrial adaptation in the crustacea. An assessment of ecological adaptation in the whole group is made by Florkin. The recent findings of sex determination in crustacea as illustrated by parasitism are discussed by Cotton. The very critical work on chitin and the formation cuticle and integumental structures is reviewed by Dennel whose account is followed by Passano on moulting and control of this most characteristic arthropod behaviour. Problems of relative growth receive critical survey in the hands of Teissier who is himself one of the pioneers in this fascinating field of bio-mathematics. The last chapter by Bliss discusses autonomy and regeneration.

The second volume is devoted to sense organs and behaviour. The opening chapter in this is by Waterman on vision which is again a field in which a very large volume of work has

\* *The Physiology of Crustacea*. Edited by T. H. Waterman (Academic Press, New York and London. India: Asia Publishing House, Bombay), 1960, Vol. I: Metabolism and Growth, pp. 1-670, Price \$ 22; 1961, Vol. II: Sense Organs, Integration and Behaviour, pp. 1-681, Price \$ 22.

appeared in recent times. Cohen and Dijkgraaf deal with mechano-reception followed by Barber on Chemoreception and thermoreception. Advances in the field of pigmentary effector system are discussed in a brilliant chapter by Kleinholz. Newton Harvey surveys the subject of light production. Wiersma contributes the next two chapters on neuro muscular system and the central nervous system. Discussion of neurohumours and neurosecretion in crustacea by Welsh follows. Lochhead deals with crustacean locomotion while Kinetic and Tactic responses form a chapter by Pardi and Papi. Physiological rhythms of crustacea, migration of various kinds and complex behaviour are reviewed in three chapters by Brown, Bainbridge and Schone respectively. The final chapter of the series is on comparative physiology by Waterman which is again an admirable review of problems of comparative physiology as applied to crustacea. In this chapter the author attempts the difficult task of comparing

crustacean physiology with that of other animal groups and has endeavoured to present certain concepts of evolutionary relationships amongst the different orders of crustacea. There is also an indication of lines of further research which might be profitable and throw light on aspects in which our knowledge is hopelessly incomplete.

These two volumes present the combined efforts of many distinguished zoologists who have worked on crustacea, and whose labours have made possible such a comprehensive approach to this group. Prof. Waterman's leadership in this effort has earned the gratitude of all zoologists, both laboratory and field workers, for this most valuable work. The Academic Press is to be congratulated on the production of these volumes which should be in the hands of every student of crustacea and of comparative physiology for many years to come.

N. K. PANIKKAR.

## LATTICE-TYPE VIBRATIONS IN ASSOCIATED LIQUIDS AND RAMAN EFFECT

IT is well known that in the spectrum of the Raman Effect in liquids even when strictly monochromatic light is used under ideal experimental conditions, the incident, or Rayleigh, line is always accompanied by a continuum which extends to several angstroms on either side of it. The origin of these Rayleigh 'wings', as they are called, has been the subject of many previous studies. In unassociated liquids and their corresponding solids, rotation of the molecules should give rise to broad wings on either side of the exciting line, the broadness of these wings depending on the rotational constant and the temperature, and in general being less than  $100\text{ cm}^{-1}$  for all but very light molecules.

In associated liquids and solids although rotations of molecules may still occur, the major cause of the Rayleigh wings probably arises from excitation of the optical modes of an associated or lattice-like structure. Such excitation of the optical modes may give rise to both a first- and a second-order Raman effect, the frequency maximum of the former corresponding to the optical frequency observed in the infra-red while the second-order Raman effect will extend out to nearly twice this frequency.

In the case of highly associated liquids, excitation of the optical branch of the quasi-lattice-

like structure has not been reported previously. In a note to *Nature* (1961, 192, 1061) J. K. Wilmshurst reports his observations on the low-frequency infra-red spectra of some highly associated liquids and their corresponding solids; e.g. water, aqueous lithium nitrate, fused lithium nitrate, chlorate and hydroxide, and fused sodium nitrate and hydroxide.

The one-angle reflection technique was used to obtain the low-frequency spectra, and the optical constants in the  $200\text{--}1000\text{ cm}^{-1}$  region have been calculated in the above cases by suitable analysis. These results show that the intense band in the low-frequency region studied can be assigned in every case to the excitation of the optical branch of a quasi-lattice, and the frequency of this band suggests that the Raman effect should show broad wings out to  $400\text{--}900\text{ cm}^{-1}$  in fused salts, and  $\sim 1600\text{ cm}^{-1}$  in aqueous solutions, consistent with the Raman spectra observations.

It would be of interest to study the anomalous Rayleigh wings more fully in highly associated liquids. In this direction the 'laser' giving an intense monochromatic light source with no spurious arc continuum, should be ideal as a Raman source and should certainly clarify this question.



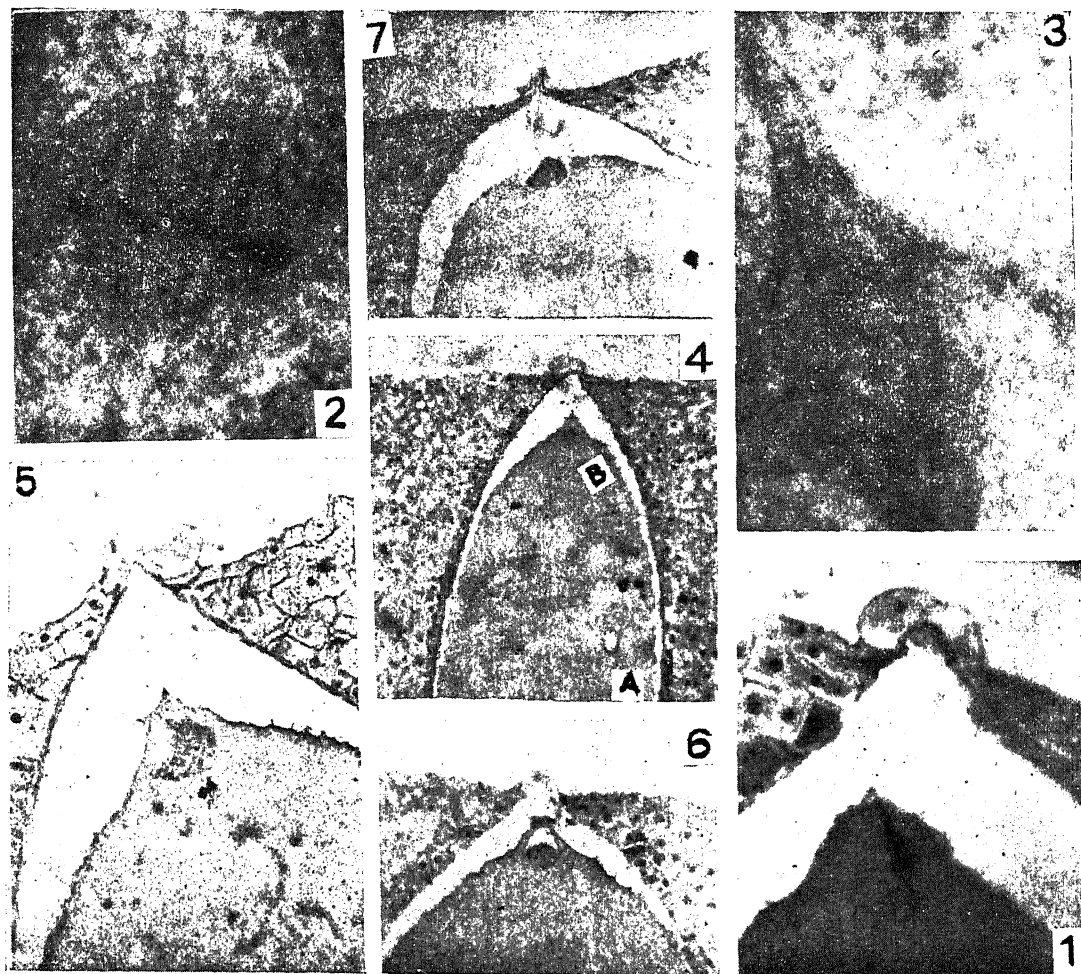
VENTRAL CANAL CELL IN *CYCAS CIRCINALIS*

L. N. RAO

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THE presence of ventral canal cell among the Cycadales was for some time in question. Strasburger (1876) appears to be the first to recognise it in *Cycas sphaerica* and Warming (1877) reported a ventral canal cell in *Ceratozamia robusta* but soon decided that he had been mistaken. Treub (1884) failed to find a ventral canal cell in *Cycas circinalis*. Hence

the impression became current that no ventral canal cell is formed in Cycadales. Ikeno (1896) announced that a ventral canal cell is formed in *Cycas revoluta* and he figured and described the mitosis that separates the nuclei of the ventral canal cell and the egg. Webber (1897) reported that in *Zamia* "a small cell is cut off at the apex of the archegonium which corresponds



FIGS. 1-7. Fig. 1. Division of the central cell nucleus showing the telophase. Note the position at the apex of the egg cell. The neck cells of the archegonium are also seen,  $\times 350$ . Fig. 2. Metaphase of another central cell nuclear division,  $\times 900$ . Fig. 3. Anaphase of another nuclear division. No sign of partition can be seen on the spindle fibres,  $\times 900$ . Fig. 4. An archegonium showing neck cell, ventral canal nucleus at B and a portion of the egg nucleus at A,  $\times 60$ . Fig. 5. Neck region of an archegonium showing the pyramidal-shaped ventral canal nucleus moving towards the periphery. Note the sharp-pointed apex of the egg cell which is also clearly seen in Fig. 4,  $\times 400$ . Fig. 6. Ventral canal nucleus just before being pushed out of the egg-cell. It looks as though the nucleus is enclosed by a cell-wall at the tip of the egg cell,  $\times 75$ . Fig. 7. The ventral canal nucleus is completely out of the egg cytoplasm before disorganisation,  $\times 75$ .

to the canal cell of Conifers". Coulter and Chamberlain (1903) in their study of *Zamia* have described the mitosis which gave rise to the nucleus of the egg and ventral canal cell. The chromosomes are very slender and inconspicuous and the spindle somewhat multipolar. Chamberlain (1906) has shown that there is a ventral canal nucleus in *Dioon* and *Encephalartos*. Swamy (1948) just states that the nucleus of the central cell in *Cycas circinalis* divides into ventral canal nucleus and the egg nucleus. The former probably begins to degenerate whereas the latter enlarges and moves towards the centre of the cell.

According to De Silva and Thambaiah (1952) in *Cycas rumphii* the division of the central cell nucleus takes place just prior to the discharge of the sperms. The ventral canal nucleus is of the same size as the parent nucleus and remains in the same position near the neck while the egg nucleus enlarges considerably as it moves away. Soon afterwards the ventral canal nucleus degenerates.

From the above account, it is evident that the position of the ventral canal cell in *Cycas circinalis* is not clear even today. In my study of *Cycas circinalis* mitotic figures which give rise to the egg nucleus and the ventral canal nucleus have been observed and figured (Fig. 1). The chromosomes are short and stumpy at the metaphase stage (Fig. 2) while they are somewhat elongated and slender at the anaphase (Fig. 3). The spindle is not multipolar as in *Zamia* (Coulter and Chamberlain, 1903). Further, there is no trace even of a partition wall and there does not appear to be any attempt even at the initiation of one at the anaphase. Compared with the huge size of the egg cell, the mitotic figure is extremely small and might easily be missed unless well-stained preparations are carefully examined.

One is tempted to doubt whether the mitotic figure belongs to this important division at all since its position in the big central cell is very peculiar. The mitotic figure occupies the extreme tip of the central cell below the neck cells (Fig. 1) leaving the great mass of protoplasm below.

These features have caused certain amount of confusion which is clearly seen in the following cases.

Swamy (1948) describes Fig. 33 as an archegonium showing two neck cells and the nucleus of the central cell. There appears to be some mistake in naming the nucleus. Judging from its position and shape the so-called central cell nucleus appears to be more like the

ventral canal nucleus. This figure is exactly similar to Plate 28, Fig. D, of De Silva and Thambaiah (1952) and they also call the nucleus as that of the central cell. Further, their Plate 27, Fig. A, is quite similar to the above Plate 28, Fig. D, and it contains the egg nucleus in addition; thereby showing clearly that what is shown in Fig. D as the nucleus of the central cell is not that of the central cell but it is the ventral canal nucleus. Plate 28, Fig. D, is exactly like Swamy's Fig. 33 and my Fig. 4. It is clear now that the so-called central cell nucleus of the above authors is not really the nucleus of the central cell but that of the ventral canal cell, though there is no cell as such formed.

Immediately after the completion of the mitosis, the nucleus of the egg begins to enlarge and move towards the centre of the cell while the other nucleus, i.e., ventral canal nucleus becomes smaller and gradually moves towards the periphery. Finally it will be pushed out of the protoplasm (Fig. 7). During this process a protrusion is formed in which the nucleus lies for sometimes still being lined by a thin layer of protoplasm. The whole structure thus looks like a cell with a nucleus (Fig. 6). At this stage the ventral canal nucleus will be roughly pyramidal in shape, its apex being directed towards the neck of the archegonium. Generally in sections, the nucleus will show a triangular outline, which characteristic feature is not shared by the egg nucleus at any stage of its growth. The protrusion in which the ventral canal nucleus lies rapidly disorganises and remains for a time as a deep staining mass at the tip of the egg. It is in all probability this protrusion that Warming (1877) described as a ventral canal cell. Ikeno (1898) states "that this portion, i.e., protuberance becomes completely separated from the egg cell".

No doubt at one stage in its outward journey the ventral canal nucleus appears to be enclosed in a cavity separated from the main mass of the cytoplasm (Fig. 6). However, there is no partition wall formed between it and the egg nucleus. It is difficult to understand how a wall that usually separates the ventral canal cell from the egg could be formed when the spindle at the anaphase stage showed no sign of wall formation and the achromatic figure disappears finally. Ikeno himself admits later that a wall may be lacking. So is the case with *Cycas circinalis*. There is no wall formed and the ventral canal nucleus is ephemeral, the protrusion in which it is lodged for a time has been mistaken for the ventral canal cell.

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## THE SOLAR WIND

RECENT theories have shown that the solar corona is too hot to be confined by the solar gravitational field. In place of the older view of the corona as an extended, but static, atmosphere it has been shown that the corona must expand continually into space. Hydrodynamic considerations show that the solar corona is steadily expanding with a velocity that is only a few kilometers per second in the lower region but which becomes supersonic at large distances from the sun.

The result is a continuing outward flow of coronal gas through interplanetary space. This is called the *solar wind* to emphasise its hydrodynamic nature, and consists of ionized atoms, mostly protons. The observed quiet-day coronal temperatures of  $2 \times 10^6$  °K indicate that the quiet-day solar wind velocity is of the order of 150 to 500 km./sec., giving a proton flux of  $10^8$  to  $10^{10}$ /cm.<sup>2</sup> sec. at the orbit of Earth.

As early as 1951, Biermann pointed out that the observed outward acceleration and the ionization and excitation of Type I comet tails could be explained only as the result of continuing quiet-day solar *corpuscular radiation*, estimated at  $10^{10}$  protons/cm.<sup>2</sup> sec. at the orbit of Earth [since revised (1960) on the basis of recent measurements of the appropriate charge exchange cross-sections, to the value  $10^9$  protons/cm.<sup>2</sup> sec.].

From the solar wind calculations it at once becomes obvious that Biermann's solar corpuscular radiation was in fact the hydrodynamic solar wind from the steadily expanding corona.

There are many other phenomena, such as the aurora, geomagnetic activity, etc., which are conventionally ascribed to solar corpuscular radiation. They too are the consequence of the solar wind. On an interplanetary scale the solar wind is hydrodynamic, but on a planetary scale its low density renders it corpuscular in many respects.

It now appears that the solar wind is the dominant interplanetary dynamical force and is responsible for the interplanetary magnetic field configuration, the observed modulation of the galactic and solar cosmic-ray intensity, the quiet day and the enhanced geomagnetic activity, etc.

The solar wind draws out into space the lines of force of the general one-gauss solar field, to give an interplanetary field that is basically spiral in character with a density of the order of a few times  $10^{-5}$  gauss at the orbit of Earth. The enhanced corona may sometimes have temperatures of  $4 \times 10^6$  °K or more immediately following a solar flare. Such explosive heating leads to a 1 to  $2 \times 10^3$  km./sec. blast wave into planetary space.

E. N. Parker of the Enrico Fermi Institute for Nuclear Studies, University of Chicago, has described in a contribution to *Jour. Res. Nat. Bur. Std.*, 1961, 65 D, 537, a solar wind model of interplanetary dynamical processes. The model based on the hydrodynamic theory of the expanding solar corona affords a deductive approach to various problems connected with interplanetary plasmas, fields, cosmic ray variations, "corpuscular" and cosmic ray effects, etc.

## LETTERS TO THE EDITOR

A NOTE ON DETECTION AND  
IDENTIFICATION OF ISOMERIC  
XYLENOLS IN THE PRESENCE  
OF ONE ANOTHER

PHENOLS are important constituents of coal-tar distillation products, pharmaceutical preparations, plant extracts, etc. Although tests exist for identification of phenols as a class, the identification of individual members from a mixture of these presents some difficulty. Paper chromatographic methods have been attempted for the identification of some of these from a mixture.<sup>1,2</sup> Sometimes the  $R_f$  values of these do not differ appreciably from one another and this makes it difficult to characterise a particular phenol. In the study undertaken in this project, the phenols were converted into a dye by condensing with a diazotised substituted aniline and the  $R_f$  values were studied. From these, methods were evolved particularly for the identification of mixtures of isomeric phenols. In the present case a special study has been made of 2, 6-xyleneol and 3, 6-xyleneol.

The two phenols were purified by distillation and M/100 solution of each of the phenols was prepared by dissolving the requisite quantity in benzene.

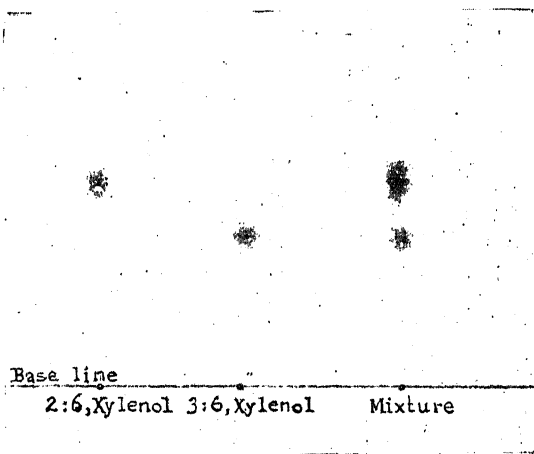


FIG. 1. Chromatography of condensation product of diazotised Amino J. Acid and Xylenols.

p-Nitro-aniline, sulphanilic acid, Amino J. Acid (2-Naphthylamine, 5, 7 disulphonic acids) and Amino G. Acid (2-Naphthylamine 6:8 disulphonic acid) were used as condensing agents

after diazotisation; M/100 solutions of these condensing agents were prepared by dissolving the requisite quantities of these reagents in water and the diazo compound prepared in the usual manner.

Sulphuric acid used was 35% and caustic soda 8%. Sodium nitrite solution was also M/100.

## ELUENTS

Different mixtures were tried and some of the most important of these are listed below:—

1. Iso-amyl alcohol: 40 ml.; Ethyl-alcohol: 40 ml.;  $\text{NH}_4\text{OH}$  (10%): 25 ml.
2. Iso-butyl alcohol: 20 ml.; Methyl alcohol: 20 ml.;  $\text{NH}_4\text{OH}$  (10%): 20 ml.
3. Secondary butyl alcohol: 10 ml.;  $\text{Na}_2\text{CO}_3$  (10%): 40 ml.
4. Methyl N-propyl ketone: 35 ml.; Methyl alcohol: 15 ml.;  $\text{NH}_4\text{OH}$  (10%): 50 ml. [or  $\text{NaOH}$  (4%): 50 ml.].
5. Secondary butyl alcohol: 25 ml.;  $\text{Na}_2\text{CO}_3$  (5%) or (10%): 50 ml.
6. Secondary butyl alcohol: 10 ml.;  $\text{Na}_2\text{CO}_3$  (5%): 50 ml. or (10%) 50 ml.
7. Iso-amyl alcohol: 10 ml.;  $\text{NH}_4\text{OH}$  (10%): 50 ml.—*Tera* methyl ammonium hydroxide (4%): 50 ml.
8. Iso-amyl alcohol: 5 ml.;  $\text{Na}_2\text{CO}_3$  (2%): 50 ml.

In cases where the eluent formed two layers, the aqueous layer was used.

## FILTER-PAPER

Filter-paper Whatman No. 1 was used.

## PROCEDURE

One drop of the solutions of each of the phenols 0.005 ml. nearly under examination was applied separately on the base line of the filter-paper. One drop of the diazotised condensing agent was applied on the phenol followed by a drop of sodium hydroxide so that the dye was formed *in situ*. The filter-paper was placed in a trough containing the eluent under examination, and immediately covered with a bell jar. The spot was allowed to develop and the extent of its movement in relation to the liquid front measured.

Several permutations and combinations of condensing agent and eluent were tried for a particular phenol. Following are the conclusions on single phenols.

into the complex. It is interesting that the value of  $pK$  for the cadmium-glycine complex obtained in the present work agrees well with the value (9.90) obtained by others.<sup>2</sup> The half-wave potential does not change when the pH is altered from 11.3 to 12.3 in spite of the fact that in a few cases (conc. of amino-acid  $< 0.2$  M.) a slight precipitation of cadmium hydroxide

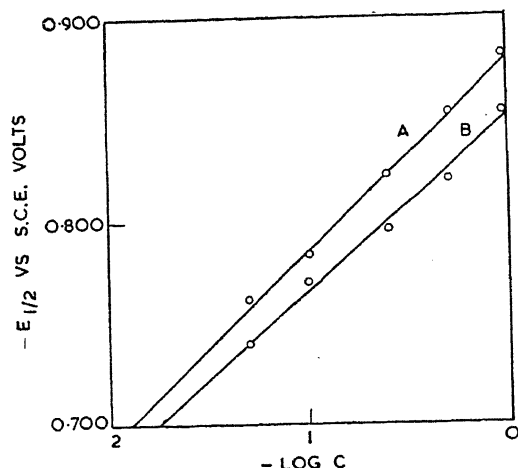


FIG. 1. Variation of half wave potential of cadmium-amino-acid complex with the concentration of (A) Glycinate; (B) Alaninate.

occurred. It may therefore be concluded that the composition of the complex in the solution remains the same. However when the pH of the solution is increased beyond 13 in solutions where precipitation does not occur, the half-wave potential is increased. The extent of increase in the half-wave potential indicates that one hydroxy group has entered into the complex. Preliminary studies made on the precipitation pH of cadmium hydroxide from 0.1 M solutions of amino-acids indicates that below the precipitation pH no hydroxy group has entered into the complex. Further work is in progress.

The authors wish to thank Prof. M. R. A. Rao for his kind interest in the work.

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Bangalore-12,  
February 1, 1962.

G. NAGESWARA RAO.  
R. S. SUBRAHMANYA.

## LEUCOCYANIDINS FROM THE SEEDS OF LITCHI CHINENSIS

THE popular fruit of *Litchi chinensis* has a single hard brown seed. Preliminary tests indicated that it was rich in leucoanthocyanidins. The powdered seeds were therefore extracted with cold acetone. From the concentrate, fatty matter and other components were removed by extraction with petroleum ether and ether. The residue consisted mainly of leucoanthocyanidins but it could be separated into two fractions, one soluble in ethyl acetate (A) and the other insoluble in this solvent (B). Both could be crystallised from hot water and had the same molecular formula and gave rise to cyanidin chloride when boiled with alcoholic hydrochloric acid, but they differed markedly in their physical properties, particularly in their solubility in ethyl acetate and in the melting points of their derivatives. The melting points and rotations of the derivatives of the two leucocyanidins are recorded in Table I.

TABLE I

Leucocyanidin (A)	Leucocyanidin (B)
1 Methyl ether, m.p. 153-161° $[\alpha]_D^{20}$ , +38.6 (in acetone)	Methyl ether, m.p. 282-290° (decomp.) $[\alpha]_D^{20}$ , +130 (in dimethylormamide).
2 Acetate, m.p. 218-226° $[\alpha]_D^{20}$ , -43 (in acetone)	Acetate, m.p. (decomp. 262°) $[\alpha]_D^{20}$ , +82.9 (in acetone)
3 Methyl ether acetate, m.p. 175-182° $[\alpha]_D^{20}$ , +32.7 (in ethylacetate) and $[\alpha]_D^{15}$ , +48.5 (in acetone)	Methyl ether acetate, decomp. above 280° $[\alpha]_D^{20}$ , +145.6 (in acetone)

Thus A and B appear to be isomeric leucocyanidins, characterised by marked differences. The occurrence of isomeric melacacidins has been recently reported by Clark Lewis and Mortimer.<sup>1</sup> The difference in this case was found to be in the capacity of one of them to form an ethyl ether readily with ethyl alcohol. Melacacidin did not form an ether whereas the isomeric compound, isomelacacidin formed the 4-ethyl ether. This difference was used for the separation of the isomers.

In experiments aimed at preparing the acetone derivatives, the leucocyanidins A and B were heated with acetone and zinc chloride at various temperatures. The preparation of these derivatives was not successful but a new observation has been made. If an acetone solution of the leucocyanidin (A or B) and zinc chloride

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is treated with toluene and boiled to remove the acetone, a deep purple semisolid separated from the toluene layer. On adding water it yielded a blue violet solid which was found to contain zinc and which was insoluble in ordinary organic solvents. The metal was held fairly strongly and required for its removal long boiling with alcoholic hydrochloric acid and even the product which is devoid of zinc is deep blue violet, but is soluble in ethanol and to a small extent in aqueous hydrochloric acid. The significant observation is that leucocyanidins obtained from other sources do not give this reaction. Consequently this observation may be useful in the study of the stereochemistry of leucoanthocyanidins.

Chemistry Department,  
University of Delhi,  
Delhi-6, December 21, 1961.

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T. R. SESHADRI.

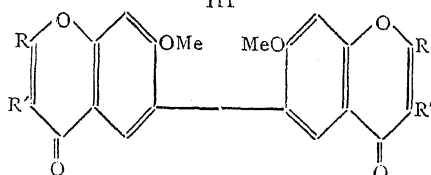
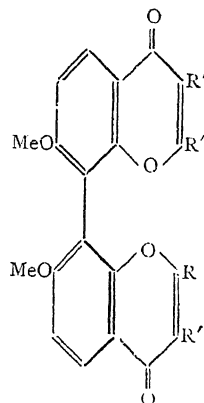
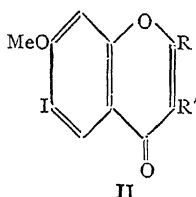
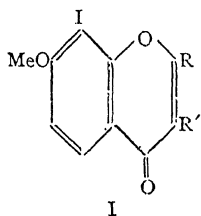
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# SYNTHESIS OF SOME BICHROMONYLS, BIFLAVONYLS AND 7-METHOXY-8-PHENYL-2-METHYLCHROMONE AND -FLAVONE\*

A NUMBER of biflavonyls have been found to occur in nature.<sup>1</sup> Recently Chen *et al.*<sup>2</sup> have reported the synthesis of some simple biflavonyls. After the present work was completed Jurd<sup>3</sup> reported the synthesis of 7, 7'-dimethoxy-8, 8'-biflavonyl. No synthesis of bichromonyls has been reported in the literature so far.

7-Methoxy-6-iodo- and 7-methoxy-8-iodo-2-methylchromone (II *a* and I *a*) on Ullmann reaction gave the corresponding 6, 6'- and 8, 8'-bichromonyl derivatives (IV *a* and III *a*).

7-Methoxy-8-iodoflavone (I *b*) on a similar reaction gave the 8, 8'-biflavonyl derivative (III *b*). As 7-methoxy-6-iodoflavone could not be obtained by the debenzoylation of 7-methoxy-6-iodo-3-benzoylflavone,<sup>4</sup> the 3-benzoyl derivative (II *c*) itself was subjected to the Ullmann reaction and the corresponding 6, 6'-biflavonyl derivative (IV *c*) obtained.



	<i>a</i>	<i>b</i>	<i>c</i>
R ..	Me	Ph	Ph
R' ..	H	H	Bz

Crossed Ullmann reaction between iodobenzene and iodochromone and -flavone (I *a* and *b*). yielded mixtures of various products from which the corresponding 8-phenyl derivatives were isolated in a pure state.

The yields in all the above Ullmann reactions were poor (below 15%). A good deal of tarry matter was obtained.

All the above bichromonyls, biflavonyls and 8-phenyl derivatives except (IV *c*) were demethylated to the corresponding hydroxy derivatives.

## EXPERIMENTAL

*Synthesis of bichromonyls and biflavonyls.*—The iodo derivative (0.01 mole) was intimately mixed with copper bronze (0.03 mole) in a test-tube and inserted in a previously heated oil-bath maintained at temperatures shown in Table I. The heating was continued for 10 minutes and the reaction mixture was first extracted with petroleum ether (to remove the de-iodinated product) and then with benzene. The benzene extract on dilution with petroleum ether gave the solid product which crystallised from dilute alcohol in needles.

*Demethylations.*—Demethylations were carried out in case of (III *a*, *b* and IV *a*) with aluminium chloride by refluxing in dry benzene for 3 hours. The bichromonyl and biflavonyl (III *a*

TABLE I

No.	Iodo derivative	Reaction temp.	Product	M.P.	Formula	Analysis %	
						Calculated	Found
1	Ia	.. 230-35°	IIIa	249°	C <sub>22</sub> H <sub>18</sub> O <sub>6</sub>	C, 69.8 H, 4.8	69.8 4.7
2	Ib	.. 235-40°	IIIb*	238-40°†	C <sub>32</sub> H <sub>22</sub> O <sub>6</sub>	C, 76.5 H, 4.4	76.2 4.6
3	IIa	.. 240-45°	IVa	282°	C <sub>22</sub> H <sub>18</sub> O <sub>6</sub>	C, 69.8 H, 4.8	69.9 4.6
4	IIc	.. 280-90°	IVc	315°	C <sub>46</sub> H <sub>30</sub> O <sub>8</sub>	C, 77.7 H, 4.2	77.5 4.6
5	Ia and iodobenzene	235-40°	7-Methoxy-8-phenyl-2 methylchromone	180°	C <sub>17</sub> H <sub>14</sub> O <sub>3</sub>	C, 76.7 H, 5.3	76.7 5.4
6	Ib and iodobenzene	240-45°	7-Methoxy-8-phenyl-flavone	168°	C <sub>22</sub> H <sub>16</sub> O <sub>3</sub>	C, 80.5 H, 4.9	80.2 5.1

\* Also obtained by refluxing the reaction mixture in diphenyl ether for half an hour after removal of diphenyl ether by steam distillation. † It softens at 168° Jurd (*loc. cit.*) give the same m.p.

TABLE II

Demethylation products of compounds described in Table I

No.	M.P.	Formula	Analysis %	
			Calculated	Found
1	365°	C <sub>20</sub> H <sub>14</sub> O <sub>6</sub>	C, 68.6 H, 4.0	68.6 4.2
2	392°	C <sub>30</sub> H <sub>18</sub> O <sub>6</sub>	C, 75.9 H, 3.8	75.6 4.1
3	>400°	C <sub>20</sub> H <sub>14</sub> O <sub>6</sub>	C, 68.6 H, 4.0	68.6 4.5
4	..	..	..	..
5	234°*	C <sub>17</sub> H <sub>14</sub> O <sub>3</sub>	C, 76.1 H, 4.8	75.9 4.5
6	265°*	C <sub>21</sub> H <sub>14</sub> O <sub>3</sub>	C, 80.2 H, 4.5	80.4 4.5

\* Obtained by demethylation with aluminium chloride in benzene.

and IV a) were also demethylated with hydriodic acid in acetic anhydride by heating at 125-130° for 3 hours.

**Synthesis of 8-phenyl-chromone and -flavone.**—A mixture of the iodo derivative (0.01 mole), iodobenzene (0.02 mole) and copper bronze (0.07 mole) was heated for half an hour in the case of (Ia) and for one hour in the case of (Ib). The reaction mixture was then washed with cold petroleum ether (b.p. 60-80°) to remove iodobenzene and biphenyl. The residue on extraction with hot benzene and petroleum ether (b.p. 60-80°) mixture (50%) gave the 8-phenyl derivative which crystallised in colourless needles from dilute ethyl alcohol.

Thanks are due to Professor Suresh Sethna for suggesting the problem and for keen interest in the course of the work. Thanks are also due to Dr. S. S. Lele for micro-analysis and the Government of India for the award of a Senior Research Scholarship.

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## EVALUATION OF DIETARY GELATIN IN TERMS OF LIVER XANTHINE OXIDASE ACTIVITY

LIVER xanthine oxidase activity is found to decrease in animals suffering partial or complete protein deficiency.<sup>1-8</sup> Litwack *et al.*<sup>9,10</sup> have demonstrated that liver xanthine oxidase activity is related to the quality of dietary protein and have evaluated the 'protein quality' of casein, lactalbumin, meat protein and gliadin in terms of liver xanthine oxidase activity. By 'protein quality' is meant the value of a dietary protein in promoting synthesis of tissue proteins and enzyme proteins in the body.

It is well known from growth studies that gelatin is a poor quality protein as it is deficient in some of the essential amino-acids like methionine. The scope of the present work was to evaluate the 'protein quality' of gelatin in terms of liver xanthine oxidase activity of animals fed gelatin as protein. The enzyme method of evaluation of a dietary protein obviates some of the interferences encountered in the growth method as the hormonal state of

the animals, water intake and water balance, fat deposition, etc.

Liver xanthine oxidase activity was estimated by the method of Litwack *et al.*<sup>11</sup> The comparison of liver xanthine oxidase activity of rats fed gelatin as protein was made with that of rats fed casein in an isonitrogenous level. It was found by semi-micro Kjeldahl estimation that 20% casein in the diet was isonitrogenous with 16.5% gelatin.

Two groups of 4 albino rats with an initial weight of  $80 \pm 10$  gm. were fed two different diets for a period of 25–28 days. The diets were the same in all ingredients except that one had 20% casein and the other 16.5% gelatin instead of casein. The deficiency in the percentage composition in case of the gelatin diet was made good with sucrose. Weights of rats were recorded every week. The rats on gelatin diet lost considerable weight and became very weak in about 20–25 days. Rats on casein diet had a steady growth and were healthy. All the rats were sacrificed at the end of the experimental period for the estimation of liver xanthine oxidase activity.

Table I of the results shows that the average liver xanthine oxidase activity of rats on gelatin diet is 70% less than that of rats on casein diet in the course of 4 weeks. This indicates that the 'protein quality' of gelatin, *i.e.*, the value of gelatin in synthesising an enzyme protein like xanthine oxidase is very poor when compared with casein. This result is corroborated by changes in body weight of the animals during the experimental period.

TABLE I

Body weight changes and liver xanthine oxidase activity in rats due to dietary casein, gelatin and enriched gelatin

Sl. No.	Dietary protein	Change in body weight at the end of 4 weeks (in gm.)		Liver xanthine oxidase activity (in $\mu$ Moles of xanthine oxidised per hour per gm. of wet liver)
		av. gain	av. loss	
1	Casein	21	—	$*9.9 \pm 0.67\uparrow$
2	Gelatin	—	20	$3.0 \pm 1.20$
3	Gelatin + Methionine	—	21	$5.9 \pm 0.45$

\* Average of 4 values.

† Mean deviation from the average.

As gelatin was found to have poor 'protein quality' by the enzyme method of evaluation, it was enriched with the required level of

methionine to the level present in casein and the 'protein quality' of this enriched gelatin was investigated. That liver xanthine oxidase activity is very sensitive to amino-acid availability in dietary protein<sup>12</sup> and to deficiencies of essential amino-acids such as methionine<sup>13</sup> has been shown by Williams and co-workers.

A concentration of 532 mg.% of methionine added to a diet containing 16.5% of gelatin will be equivalent to the amount of methionine in 20% casein diet.<sup>14</sup> Hence a similar experiment was performed by feeding a group of 4 albino rats (initial weight  $80 \pm 10$  gm.) with a diet containing 16.5% gelatin and 532 mg.% of DL Methionine for the same period. Table I of results shows that though there is no influence in the growth of rats, the liver xanthine oxidase activity is found to be doubled due to the addition of methionine to gelatin diet. This is in agreement with the finding that addition of small amounts of methionine in the diet improves the activity of liver xanthine oxidase.<sup>12</sup> Methionine seems to be necessary for maintaining xanthine oxidase activity as the active site of the latter is a sulphur-containing portion, namely a system of two ferric mercaptides between two FAD (Flavin Adenine Dinucleotide) moities.<sup>15</sup>

The author thanks Dr. T. M. B. Nedungadi, Professor of Biochemistry, Madurai Medical College, Madurai, Dr. V. Srinivasan, Director, Sarabhai Chemicals Research Institute, Ahmedabad and Prof. V. V. Raman, Head of the Department of Chemistry, Madurai Medical College, Madurai, for their guidance and encouragement.

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### CHEMICAL STRAINS OF *USNEA* *ORIENTALIS*

*Usnea orientalis* Mot. collected from two places, Kodaikanal in South India and the Himalayas in the North, was examined by Seshadri and co-workers<sup>1</sup> who reported the presence of (+) — usnic, barbatic, caperatic and stictic acids in the former, and (+) — usnic and salazinic in the latter. It was suggested<sup>2</sup> that the two samples should be considered as different chemical strains of the same lichen and not two distinct botanical species, since morphologically they were identical. Recently during the course of our investigations on the *Usnea lichens*<sup>3,4</sup> found on trees in the Nilgiris, we came across a sample of *U. orientalis*, morphologically indistinguishable from the earlier samples examined by Seshadri and co-workers.<sup>1</sup> The sample collected during the summer of 1960 was studied with a view to substantiating the earlier observation about chemical strains in lichens.

The coarsely powdered lichen was extracted by refluxing with hot benzene and acetone in succession. The combined benzene extract on working up as described earlier<sup>4</sup> yielded (+) — usnic acid (yield, 1.2%). The benzene mother liquor as well as the combined acetone extract on concentration yielded an almost colourless solid which after recrystallisation twice from acetone came out as long colourless needles, m.p. 264–65°. This was identified as psoromic acid<sup>5</sup> (yield 1.0%) by its solubility, characteristic colour reactions (ferric chloride: wine-red colour; conc. H<sub>2</sub>SO<sub>4</sub>: yellow changing to blood-red on gentle warming; bleaching powder: yellow colour) and by preparing its tri-acetate, m.p. 198–99° and anil, m.p. 295° (decomp.). The presence of ergosterol was also demonstrated by chromatography of the acetone mother liquor, after the separation of psoromic acid, on alumina and the characteristic colour reactions of the sterol.

Isolation of psoromic acid from *U. orientalis* is recorded for the first time and this provides an example of another strain of this Indian lichen. The presence of ergosterol is also recorded only now.

Lamb<sup>6</sup> proposed that morphologically indistinguishable lichen individuals which contain

distinct lichen acids should be regarded as belonging to one and the same species and the chemical difference should be expressed by the use of the term "Strain" and this view is more or less accepted by modern lichenologists. Indian strains of *Parmelia tinctorum* were reported by Seshadri and co-workers<sup>7</sup> and North American strains of *P. cetrarioides* by Culberson<sup>8</sup> and of *P. furfuracea* by Hale.<sup>9</sup> The recognition of the three different strains of *Usnea orientalis* as (1) stictic strain, (2) salazinic strain and (3) psoromic strain is justifiable on the basis of the close structural similarity of the depsidones.

We thank Prof. T. R. Seshadri for his kind interest in this work and Dr. S. G. Vengsarkar, Principal, Medical College, Pondicherry, for encouragement.

Medical College, A. G. R. NAIR.  
Pondicherry, S. SANKARA SUBRAMANIAN.  
October 6, 1961.

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### A NOTE ON THE CURARIFORM PROPERTIES OF AN ALKALOID ISOLATED FROM THE ROOTS OF *INULA ROYLEANA* DC

THE potent alkaloidal ingredients of curare, the well-known South American arrow poison, are used in medicine as muscle relaxants, because of their neuromuscular blocking effect. These alkaloids are distributed among plants of several strychnos species and several genera of Menispermaceæ.

Pradhan *et al.* (1952-1953)<sup>1,2</sup> have reported the pharmacological properties of an alkaloid (hayatin) isolated from *Cissampelos pareira* Linn. and found that it possessed potent curarising activity.

While investigating the preliminary pharmacological properties of the alkaloids (roylene,

inuline and amorphous base), isolated by Handa *et al.* (1958)<sup>3</sup> from the roots of *Inula royleana* DC, the amorphous alkaloid was found to depress respiratory movements and on further investigation to be a muscle relaxant. This communication presents the results of studies on the curariform properties of the amorphous alkaloid.

The curariform activity was tested on anaesthetised (Phenobarbitone) dogs, whose gastrocnemius was made to contract six times per minute in response to electrical stimulation of sciatic nerve. From the depression of the contraction caused by the substance, the curariform activity was assessed. The alkaloid in graded doses from 0.5–1.2 mg./kg. administered intravenously produced depression of contraction, thus showing a neuromuscular blockade (Fig. 1). A dose of 1.2 mg./kg. of the alkaloid produced quantitatively the same effect as 0.2 mg./kg. of D-tubocurarine. The curariform activity of the alkaloid was antagonised by prostigmin (Fig. 2). Tested on mice the alkaloid produced a well marked paralysing effect on skeletal muscles observed by placing the drugged animals on an inclined screen and noting the sliding down effect. Doses from 15–20 mg./kg. produced paralysis of limbs in mice.

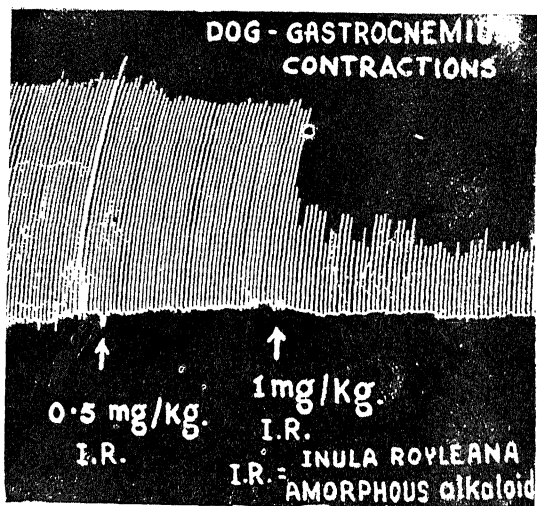


FIG. 1

The alkaloid produced a fall of blood pressure, which is not prevented by atropinisation or bilateral vagotomy. In smaller doses it stimulated respiration both in frequency and amplitude and then depressed it. Higher doses caused

stoppage of respiration due to paralysis of respiratory muscles. No definite action was found on intestine and uterus.

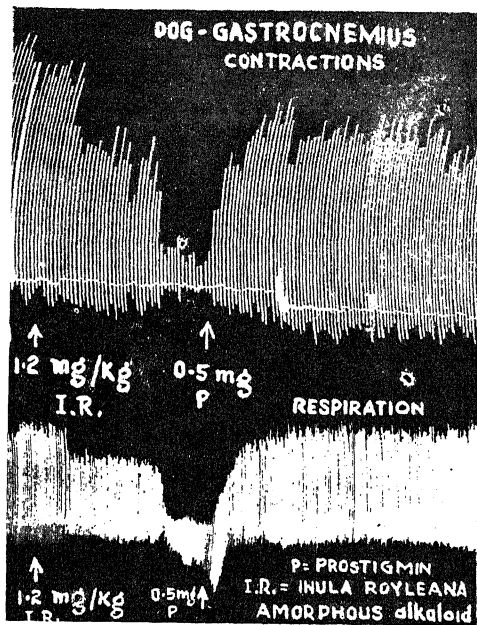


FIG. 2

Acute toxicity was tested on albino rats (80–120 gm.) and I/P L/D 50 calculated by the method of Litchfield and Wilcoxon<sup>4</sup> was 20 mg./kg. Chronic toxicity was determined in albino rats. A dose of 10 mg./kg., administered I/P for three weeks, did not produce any untoward effect or caused significant loss of weight.

The alkaloid possesses a definite curariform activity but it seems weaker than D-tubocurarine.

The authors are grateful to Dr. I. C. Chopra for his valuable guidance and keen interest in this study.

Regional Research Lab.,  
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# STUDIES ON THE COMPOSITION OF LIQUID AND SOLID FRACTIONS OF THE SAME GHEE

SOME samples of ghee, on standing at room temperature (28–30° C.), separate into liquid and solid fractions. This feature has a close bearing on the routine analysis of ghee as the two fractions, if their compositions are different, must be well mixed before sampling and analysis. Arup has given some data on the composition of liquid and solid fractions of some Irish butter-fats.<sup>1</sup> But, no mention has been made of the behaviour of the two important constants, B.R. and saponification values. The Reichert tended to be higher in the liquid portion. Evidence of further work in this line being rather scanty, studies were undertaken to determine the compositions of the liquid and solid fractions.

Samples of ghee which separated at the laboratory temperature (23–30° C.) were taken, and in each case, the entire sample was first analysed for B.R. at 40° C., Reichert and in some cases, saponification value. After separation into two layers at laboratory temperature, the sample was filtered through No. 1 Whatman paper. The liquid portion filtering through and the remaining solid portions were analysed separately for B. R., Reichert and saponification values.<sup>2</sup> Some of the results are given in Table I.

TABLE I

Sl. No.	Description	B.R. at 40° C	Reichert	Saponification value	Remarks
1	Original (Entire)	40.6	33.5	232.0	Solid fraction predominates
	Liquid Fraction	40.3	36.1	233.4	
	Solid Fraction	40.4	32.8	250.9	
2	Original	41.4	31.8	..	Solid and Liquid fractions almost equal
	Liquid Fr.	41.4	34.3	233.4	
	Solid Fr.	41.7	28.1	226.6	
3	Original	41.6	31.1	..	Liquid fraction predominates
	Liquid Fr.	41.6	32.7	229.7	
	Solid Fr.	41.8	29.0	224.0	
4	Original	42.0	29.5	..	Solid fraction predominates
	Liquid Fr.	41.8	33.3	228.6	
	Solid Fr.	41.9	27.5	222.7	

In all cases it was observed that the Reichert of the liquid fraction is invariably higher than that of the solid fraction. Saponification value is also higher in the liquid fraction. But, the B.R. is practically unchanged in the two fractions, and is almost the same as that of the entire sample.

Further, the Reichert of the original ghee tends towards the value of that fraction which predominates. If solid and liquid portions are almost equal in amount the Reichert of the entire sample is nearly the arithmetic mean of the values of the two fractions (Sample No. 2). In Samples No. 1 and 4 where the solid fraction predominates, the Reichert of the entire sample has tended towards that of the solid fraction.

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## VARIATION OF ULTRASONIC VELOCITIES IN CHARNOCKITES

BOTH longitudinal ( $V_L$ ) and torsional ( $V_T$ ) ultrasonic velocities in Km./sec. have been determined in a number of charnockites employing the Wedge method<sup>1</sup> and are tabulated in Table I along with density ( $\rho$ ) in gm./c.c., Young's modulus  $Y$ , rigidity modulus  $n$  and bulk modulus  $K$  in  $10^{11}$  dynes/cm.<sup>2</sup> and Poisson's ratio  $\sigma$ .

TABLE I

Sl. No.	$\rho$	$V_L$	$V_T$	$Y$	$n$	$K$	$\sigma$
AK <sub>1</sub>	.. 2.64	6.1	3.1	6.2	2.5	6.7	.33
AK <sub>2</sub>	.. 2.68	6.0	3.0	6.4	2.4	6.5	.34
AP <sub>1</sub>	.. 2.63	6.0	3.1	8.3	2.5	6.3	.33
AP <sub>2</sub>	.. 2.42	6.1	3.0	7.3	2.2	6.2	.34
IK <sub>1</sub>	.. 2.66	6.3	3.1	6.7	2.5	7.1	.34
IK <sub>2</sub>	.. 2.83	6.3	3.2	7.6	2.8	7.3	.33
BP <sub>1</sub>	.. 3.06	6.3	3.2	8.3	3.1	8.0	.32
BP <sub>2</sub>	.. 3.06	6.2	3.2	8.2	3.1	7.7	.32
BP <sub>3</sub>	.. 3.05	6.4	3.2	8.6	3.2	8.4	.33
BP <sub>4</sub>	.. 3.01	6.4	3.3	8.6	3.2	8.0	.32
BP <sub>5</sub>	.. 2.99	6.5	3.3	8.7	3.3	8.2	.32
BK <sub>1</sub>	.. 2.68	6.5	3.3	7.6	2.9	7.4	.33
BK <sub>2</sub>	.. 2.67	6.4	3.4	8.0	3.1	6.8	.30
UK <sub>1</sub>	.. 3.12	6.7	3.7	10.9	4.2	9.7	.28
UK <sub>2</sub>	.. 3.36	6.6	3.7	11.5	4.5	8.5	.28
UK <sub>3</sub>	.. 3.07	6.6	3.5	9.7	3.7	9.2	.32

The specimens have been chosen from two typical areas, Kondapalle (K) and Pallavaram (P) where different types, namely, acid (A), intermediate (I), Basic (B) and ultra-basic (U) are known to occur in distinct outcrops. The subscript indicates the serial numbers of specimens in both the areas respectively. Petrographic examination reveals that in acid varieties, Hypersthene is present in clusters and is not fresh. Enstatite is always associated with

the ultra-basic rocks. Garnet occurs in all the varieties of Kondapalle charnockites. Quartz shows wavy extinction in all the cases. These observations are in general agreement with

those of Leelanandam.<sup>2</sup> Modal analysis for all the sections have been made and the results are given in Table II.

TABLE II

S. No.	Quartz	Perthite	Plagioclase	Orthopyroxene	Clinopyroxene	Hornblende	Enstatite	Biotite and Fe ores	Garnet	Accessories
1	2	3	4	5	6	7	8	9	10	11
AK <sub>1</sub> ..	26.48	52.27	3.79	3.79	..	..	..	4.30	8.41	0.95
AK <sub>2</sub> ..	28.60	46.78	15.22	2.08	..	..	..	5.71	1.45	0.16
AP <sub>1</sub> ..	48.75	35.36	15.12	0.05	..	..	..	0.72	..	..
AP <sub>2</sub> ..	52.26	34.00	13.74	..	..	..	..	..	..	..
IK <sub>1</sub> ..	30.42	35.88	15.33	7.63	..	..	..	5.95	2.20	2.59
IK <sub>2</sub> ..	26.77	12.75	40.66	18.85	..	..	..	0.97	..	..
BK <sub>1</sub> ..	5.43	2.78	39.87	13.75	16.77	18.65	..	2.34	0.41	..
BK <sub>2</sub> ..	3.15	1.58	37.94	10.39	26.99	13.17	..	6.78	..	..
BP <sub>1</sub> ..	5.94	8.80	39.83	20.98	14.87	4.89	..	4.66	..	..
BP <sub>2</sub> ..	2.78	15.88	36.76	35.94	0.76	..	..	6.28	..	..
BP <sub>3</sub> ..	4.24	3.74	41.84	6.56	10.87	30.78	..	2.78	..	..
BP <sub>4</sub> ..	2.74	0.56	44.23	15.43	4.32	31.53	..	1.19	..	..
BP <sub>5</sub> ..	1.62	..	50.03	6.00	5.11	36.73	..	0.51	..	..
UK <sub>1</sub> ..	..	..	1.76	18.00	11.06	..	69.18	..	..	..
UK <sub>2</sub> ..	..	..	13.94	2.18	58.43	5.40	6.40	..	..	..
UP ..	..	..	27.89	14.39	4.18	52.31	..	1.23	..	..

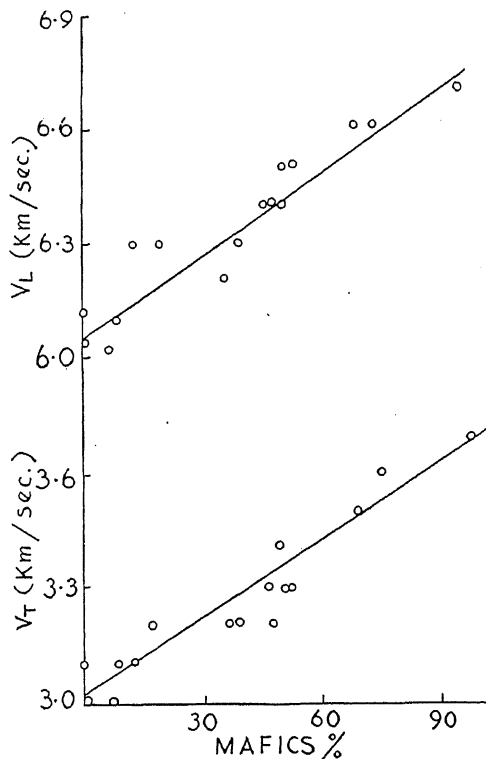


FIG. 1

An examination of Table II suggests that there is a decrease in quartz content and increase in felspar as we pass from acid to basic members. In the ultra-basic rocks, however, quartz is completely absent, felspar content decreases and a consequent high increase in mafic minerals is noticed. In fact the proportion of mafic minerals varies gradually from the intermediate to ultra-basic varieties. This is nicely correlated with the ultrasonic velocities and shows a linear relationship, as can be seen from the graph.

The velocity values in acid charnockites generally correspond to those in granites and this is what is to be expected since their mineralogical assemblage is almost similar. Further investigations are likely to throw some light on the problem, the mode of origin of these interesting rock types which occupy a considerable portion in the Eastern Ghats.

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# NOTE ON THE DISCOVERY OF STROMATOLITIC STRUCTURE FROM THE LOWER SHALI LIMESTONE OF TATAPANI, NEAR SIMLA, H.P.

IN May 1961, the writer discovered stromatolitic structures in the dolomitic limestone exposed along the left bank of the Sutlej river at Tatapani in Mandi district of Himachal Pradesh, about 10 miles north of Simla. Here the Lower

pattern of inverted column of bowls. Megascopically, the individual colonies are elongate-columnar, their length far exceeding the width. The direction and rate of growth are far less regular, so that the columns deviate from complete vertical attitude and the width from bottom to top is perceptibly variable. A notable feature is that towards the top the colonies bifurcate (Fig. 2). They consist of alternating

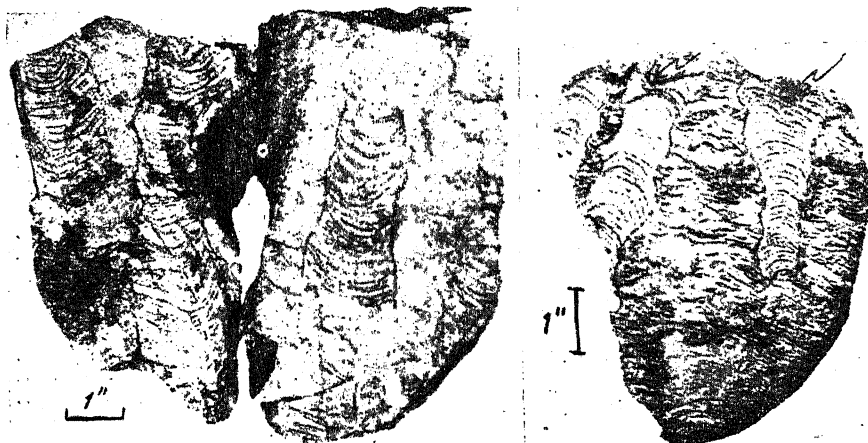


FIG. 1. The stromatolites resemble *Collenia* Precambrian dolomites of the Marion Lake, Canada. algal colonies.

*septentrionalis* Fenton and Fenton, 1939, from the The arrows point out the points of bifurcation of the

Shali Limestone, comprising thickly-bedded greyish white dolomitic limestones, is exposed along the core of an eastwardly pitching anticline. The anticline constitutes a tectonic window beneath the overthrust mass of the Shail series. The Shali Thrust is the source of the famous hot springs of Tatapani.

According to West,<sup>1</sup> the following is the complete sequence of the Shali series:—

## MADHAN SLATES

Shali Quartzites—Pure white quartzites containing chert.

Upper Shali Limestone—Massive grey, cherty dolomitic limestone full of parallel sheets of chert.

Shali Slates—A variety of slates and slaty limestone.

Lower Shali Limestone—Massive grey dolomitic limestone with only occasional chert banded at the base.

Khaira Quartzites.

The Lower Shali Limestone contains the stromatolitic structure described below.

## DESCRIPTION OF THE STRUCTURE

The framework of the bioconstructed structure comprises columnar colonies, simulating the

greyish white dolomitic and dark grey cherty laminae, ranging in thickness from 0.50 to 1.00 mm. The transition between the bottom of the algal colonies and the underlying compact dolomitic limestone is rather abrupt, the arched laminae evince but slight tendency for accentuated curvature upwards. In weathered sections, the colonies terminate in vaguely domed upper surfaces. The colonies are quite isolated, being separated by non-laminate cherty dolomitic limestone.

Microscopically, the texture is generally very fine-grained, demonstrating no recognizable structures other than the megascopically visible laminae. However, very thin, film-like laminae of black chert showing slightly tortuous disposition alternate with fine-grained or partially recrystallised layers.

The above structure very closely resembles *Collenia septentrionalis* Fenton and Fenton,<sup>2</sup> 1939, occurring in the Early or Middle Precambrian dolomites of the island in the Marion Lake, North-west Territories, Canada.

## STRATIGRAPHIC SIGNIFICANCE

The Shali series is commonly correlated with the Krol series (Krishnan,<sup>3</sup> Pascoe<sup>4</sup>) of the

Permocarboniferous period. Boileau, as quoted by Krishnan and Swaminath,<sup>5</sup> considers it homotaxial with the Infra-Krol-Krol succession and has compared the series with the Upper Vindhyan. West<sup>1</sup> considers the Shalis to be homotaxial with the Krols, but not without doubts (p. 138). Pilgrim and West,<sup>6</sup> however, think that the Shali Limestone and its underlying slates may represent an entirely different facies or horizon of the Simla series. They state (p. 125) that the temptation to correlate the Shali Limestone with the Deobans is strong.

It is significant that "psuedo-organic structures" have been reported from the Naldera-Kakarhatti-Limestone, which form the basal horizons of the Simla series (Pilgrim and West<sup>6</sup>), and from the Deoban Limestone (Oldham<sup>7</sup>). These structures appear to be nothing but stromatolites, analogous to *Collenia* of the Calc Zone of Pithoragarh of Kumaun, Uttar Pradesh (Misra and Valdiya<sup>8</sup>). The stratigraphic range of the genus *Collenia* is from late Proterozoic to early Ordovician, but its greatest development took place during late Proterozoic and Cambrian (Dr. J. Harlan Johnson, personal communication). It is quite obvious that the correlation of the Shali series with the Naldera Limestone of the basal Simla series (Algonkian) and with the Deoban Limestone [equivalent to the Vindhyan, Wadia;<sup>9</sup> basal Cambrian (?), Krishnan<sup>3</sup>], and also with the Calc Zone of Pithoragarh, is tangibly supported.

The writer is very grateful to Professor Dr. R. C. Misra for encouragement and valuable suggestions and to his colleague Dr. A. D. Kharkwal, who led the party of post-graduate students to the area mentioned above.

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## FOSSILIFEROUS LAKI BEDS FROM KUTCH

ATTENTION has recently been drawn to the occurrence of Lower Eocene beds in Kutch by Tewari,<sup>1,2</sup> who referred certain argillaceous beds from the Vinjhan-Miani area, to the Laki Stage. These attain a thickness of about 50 feet and rest upon the Deccan Traps and associated laterites. In 1957 Tewari<sup>3</sup> again referred his bed No. C<sub>3</sub> from the Waghopadar-Sanosura section, comprising grey-brown and carbonaceous shales, yielding *Botryococcus braunii* and dicotyledonous leaves to the Lower Eocene. Earlier, Krishnan<sup>4</sup> referred the gypseous, pyritous and carbonaceous shales with lumps of fossil resin from the Tertiary rocks of Kutch to the Lakis, and considered them to be of Middle Eocene age. While summarising the Geology of Kutch Agarwal<sup>5</sup> referred, doubtfully, the Gypseous Shales of Wynne<sup>6</sup> to the Lakis.



FIG. 1. Microphotograph of light brown *Assilina* mar, (Bed No. 12) from Nareda showing *Assilina daviesi*, *Assilina subspinosa* and *Assilina granulosa*,  $\times 7$ .

The previous views are based, primarily on stratigraphic considerations without adequate palaeontological evidence in support thereof. The present investigation has yielded sufficient faunal data from the argillaceous strata, overlying unconformably the Deccan Traps of Nareda (68° 41' 30" : 23° 34' 30"), to permit the correlation with the Laki beds of West Pakistan. The author has geologically mapped parts of South-Western Kutch and has also made systematic fossil collections. The following Lower Eocene sequence obtains at Nareda :

	Thickness in feet
12. Loose light-brown and yellow marls, upper part compact, with <i>Ostrea</i> , Foraminifera and Mollusca.	9
11. Chocolate and brown plastic clays.	5
10. Ferruginous shales studded with Foraminifera and Mollusca.	2
9. Light-greenish-grey compact marl with Foraminifera and Mollusca.	1
8. Yellow shales and clays with Foraminifera and Mollusca.	1½
7. Brown shales with gypsum.	6
6. Loose glauconitic sandstone.	5
5. Gypseous brown shales of various shades.	16
4. Grey plastic clays with a calcareous band at the base with <i>Nummulites</i> cf. <i>N. mamilla</i> , <i>Nummulites atacicus</i> , <i>Cibicides</i> , <i>Rotalia</i> , <i>Quinqueloculina</i> , <i>Dentalium soriense</i> , <i>Dentalium</i> ( <i>Lævidentalium</i> ) <i>pseudorakhienae</i> , <i>Dentalium</i> sp., <i>Turritella</i> cf. <i>T. (Stiracolpus) pakistanica</i> , <i>Turritella</i> cf. <i>T. rakhienae</i> , <i>Ringicula punjabensis</i> , <i>Motyris</i> , <i>Turbonilla</i> cf. <i>T. (Chemnitzia)</i> — <i>A. soriensis</i> , <i>Rissoina</i> , <i>Caecellaria</i> and <i>Venericardia vredenburghi</i> .	10
3. Grey, yellow and brown shales, upper portion gypseous and lower carbonaceous, pyritous with resin, leaf impressions, shark teeth and vertebræ, Ostracoda, <i>Venericardia</i> , <i>Ostrea</i> and <i>Neomeris</i> at the base.	22
2. Highly gypseous ferruginous yellow and grey <i>Venericardia</i> shales.	5
1. Deccan Traps and associated laterites.	base not exposed

Beds number 8, 9, 10 and 12 of the above sequence have a common foraminiferal association of *Assilina spinosa* Davies, *Assilina subspinosa* Davies and Pinfold, *Assilina daviesi* de Cizancourt, *Assilina granulosa* (d' Archiac), *Nonion*, *Nodosaria*, *Quinqueloculina*, *Triloculina*,

*Clavulinoides*, *Spirosigmoilina*, *Cycloloculina*, *Cibicides*, *Rotalia* and *Spiroloculina*.

In general the above sequence of beds dips at a low angle of 5° to 7° towards south-west. Laki beds, yielding characteristic Foraminifera, have also been observed at the following localities in Kutch :

1. About 1¾ miles S 70° west of Branda (68° 43' 10" : 23° 34' 20") in a nala section.
2. About 1½ miles S 35° west from Branda.
3. About 2 miles S 37° west from Chakrai (68° 46' 40" : 23° 33' 35").
4. About 2½ miles from Harudi (68° 43' 40" : 23° 30' 20") on the motor road to Narain Sarovar.
5. About 1½ miles east of Lakhmirani (68° 38' 20" : 23° 34') in a stream section.

The presence of *Nummulites atacicus*, *Nummulites* cf. *N. mamilla*, *Assilina spinosa*, *Assilina subspinosa*, *Assilina daviesi* and *Assilina granulosa* proves beyond doubt that the beds enclosing the above fauna are of Lower Eocene (Laki) age and may be equivalent to the Sakesar Limestone and/or the Bhadrar beds, comprising the upper part of the Lakis of West Pakistan.

The author wishes to record his deep sense of gratitude to Prof. R. C. Misra for encouragement and valuable suggestions, and to Prof. M. R. Sahni for the kind perusal of the manuscript. The author is grateful to Dr. B. S. Tewari for guidance and to the Ministry of Scientific Research and Cultural Affairs, Government of India, for financial assistance.

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### THE MAHAR HANDPRINTS— A PRELIMINARY REPORT

THE Mahar is a numerous (about 3,500,000 in census 1931) caste of Maharashtra and neighbouring States. They are said to have a tribal origin. Risley<sup>1</sup> observed their resemblance with certain Maharashtra Brahmans in physical features. Rakshit<sup>2</sup> has noted an influence of 'Australoid and brown element' among the Mahars of Nagpur and Kamptee.

Finger and palm prints of 115 males and 116 females (Mahar) from the same places have

been studied by the writer. A detailed analysis will be published elsewhere. An outline of the major findings are presented here in Tables I and II.

TABLE I

*Fingerball patterns with S.E., pattern intensity index (P.I.I.) and quantitative value (Q.V.)*

	Whorl %	Ulnar Loop %	Radial Loop %
Male ..	33.83 ± 0.43	60.52 ± 0.45	1.83 ± 0.004
Female ..	29.82 ± 0.43	63.02 ± 0.46	1.64 ± 0.004

	Arch %	P.I.I.	Q.V.
Male ..	3.8 ± 0.01	13.00	14.91
Female ..	5.52 ± 0.01	12.44	13.70

TABLE II

*Main line formulae, indices and patterns on the palm*

	Male	Female
11.9.7- %	.. 25.30	24.14
9.7.5- %	.. 16.59	18.53
7.5.5- %	.. 19.67	22.84
Main line Index	.. 7.69	7.59
Patterns:	..	..
Hypothenar %	.. 32.17	35.77
Thenar -		
I Interdigital %	.. 10.87	12.49
II do.	.. 10.48	14.23
III do.	.. 42.24	46.12
IV do.	.. 78.20	91.38

The ridge characters of the Mahar are thus similar to those among Europids and high caste Hindus (Indids) published so far. It is worthwhile to mention that results of an official investigation (1958) on their blood groups, taste ability, colour blindness and other genetic traits, in which the author took important part, also indicate similar affinities.

The IV Interdigital patterns, however, show a departure from this general trend. This may be due to miscegenation or inbreeding, instances of which were not very rare to find.

DEBA PRASAD MUKHERJEE.

Anthropological Survey of India,  
Government of India,  
Calcutta, August 6, 1961.

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## THE NEMATODE GENUS *SYPHACIA* SEURAT, 1916 IN DOG

ON two occasions, while collecting helminth parasites of dog, three female worms, of which two were gravid, were recovered from large intestine. The specimens  $5.6-6.0 \times 0.343-0.45$  in dimensions, with a well-developed cephalic vesicle of  $0.10-0.136$  diameter, having transverse striations extending throughout the body behind but absent from region of tail. Mouth, with three distinct lips, leading into a short but tubular pharynx followed by oesophagus, club-shaped anteriorly and provided posteriorly with a large spherical bulb, having characteristic prebulbar swelling separated by a short but sharp constriction; pharyngeal and oesophageal region, including bulb,  $0.98-1.016$  in length, the bulb having a diameter of  $0.18-0.216$  and prebulbar swelling with a width of  $0.1-0.116$ ; nearly straight intestine, narrowing posteriorly, in its beginning with a diameter of  $0.20-0.216$  but behind  $0.116$ . Vulva, post-oesophageal in position, at  $1.566-1.98$  distance from anterior extremity; muscular vagina,  $0.250$  in length and  $0.113-0.150$  in width, leading into the two uterine branches running posteriorly parallel and extending to a little distance in front of anus. Pointed tail, sinuous in character,  $1.00-1.117$  in length. Intra-uterine eggs near ovjector, oval but slightly flattened on one side and measuring  $40-44 \times 13.5-16.8 \mu$  in size.

The specimens belong to the pinworm genus *Syphacia* but, in the absence of male specimens, a systematically specific identification is not possible. This genus, with its many species, has mostly been recorded from rodents except the three forms—*S. bonnei* van Thiel, 1925, from monkey, *S. srivastavai* Sinha, 1960, from domestic pig and *S. obvelata* (Rud., 1802) Seurat, 1916—the type species, which in addition to its rodent host has also been found as parasite of man (Yorke and Maplestone, 1926; Faust, 1949). Amongst the twenty-six species known under this genus, *S. srivastavai* surprisingly has a peculiar habitat as it has been reported from the stomach while all other species are from the large intestine of various hosts. This genus, as far as could be ascertained, does not seem to have been reported from dog in any country. The present report, thus, would be the first record of this genus in this animal.

(All measurements in mm.)

Thanks are due to Prof. Dr. B. P. Pande, for his guidance in preparation of this manuscript and to the Principal of the College for facilities provided.



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### A NOTE ON A NEW TREMATODE SUBFAMILY SINGHIATREMINEAE

THE writer collected trematode parasites of the genus *Singhiatrema* Simha, 1954, in larger numbers from the cloaca of water-snake, *Tropidonotus piscator* and the rectum of rat snake, *Ptyas (Zamenis) mucosus*. The infection was heavy in the months of June and July. A close examination of the live material revealed that the genus *Singhiatrema* Simha, 1954, cannot be assigned to any of the known subfamilies of the family Echinostomidae.

The new subfamily shows close affinities with the subfamily *Parorchinae* Lal, 1936, but it can, however, be differentiated from the latter by the following main characters:—

1. The sequence in the coronet of spines, present on the head crown being broken dorsally.
2. The non-spinous nature of the cuticle.
3. In the presence of an elongated and sac-like receptaculum seminis.
4. The seminal vesicle being placed immediately in front of the acetabulum and enclosed within the cirrus sac.
5. The common genital pore being surrounded by a "sucker-like structure".
6. The excretory bladder being a short transversely placed contractile vesicle more or less 'V'-shaped with a short median stem, which branches off into two diverticula, which extends forward into the region of the oral sucker.

The new subfamily also reveals close kinship with the subfamily *Ommatobrephinae* of the family *Ommatobrephidae* Poche, 1926. The two subfamilies resemble each other in every respect, except the following two main features:

1. There is a coronet of 22 spines broken dorsally on the head crown in the new subfamily,

whereas it is completely absent in *Ommatobrephinae*.

2. There is a "sucker-like structure" round the common genital pore in *Singhiatreminae*, but there is no such structure in *Ommatobrephinae*.

In view of the above-discussed characters of the genus *Singhiatrema* Simha, 1954, it becomes necessary to establish a new subfamily *Singhiatreminae*.

#### SUBFAMILY DIAGNOSIS

Echinostomes, having pear-shaped or elliptical body; cuticle non-spinous; head crown with 22 well-developed spines, arranged in a single coronet, sequence being broken dorsally; oral sucker terminal and smaller than ventral sucker; prepharynx small; pharynx globular, followed by an elongated oesophagus; intestinal caeca terminate anterior to gonads; excretory pore subterminal; bladder consisting of a short transversely placed contractile vesicle with a short median anterior stem, dividing into two lateral diverticulae; common genital pore surrounded by a sucker-like structure located between intestinal fork and acetabulum; gonads caudal in position, testes lobed or smooth, laterally situated at the posterior part of the body with their anterior ends diverging. Cirrus sac in front of the acetabulum; cirrus small; ovary small and oval in outline; elongate sac-like receptaculum seminis present. Vitellaria follicular, distributed in the pre-testicular zone. Eggs in anterior coils of uterus, containing fully developed miracidia.

Hosts: *Tropidonotus piscator* and *Ptyas (Zamenis) mucosus*.

Location: Cloaca, Rectum and Intestine.

Type-genus: *Singhitrema* Simha, 1954.

Generic diagnosis: With characters as defined above.

Type species: *S. Sinkhia* 1954, from rectum of *Ptyas (Zamenis) mucosus*.

Other species: *S. longifurca* Simha, 1958, from cloaca and rectum of *Tropidonotus piscator*. *S. hyderabadensis* Simha, 1958, from intestine of *Tropidonotus piscator*.

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Nizam College, Hyderabad, A.P.,  
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# MIRACIDIUM OF *ECHINOCHASMUS*

BAGULAI VERMA, 1935

(TREMATODA: ECHINOSTOMATIDAE)

RECENTLY Ramalingam<sup>1</sup> gave an account of the morphology and life-history of the avian trematode *Echinochasmus bagulai* Verma, 1935. But, he was not successful in rearing the miracidial stage and stated that the miracidium is the most elusive stage of the genus *Echinochasmus*. However, in our investigations on *E. bagulai* occurring in the pond heron *Ardeola grayii* (Sykes) and the cattle egret *Bubulcus ibis* (Linnæus) at Andhra Pradesh, opportunities were provided to make certain observations on the life-history. The eggs collected from the faeces of infected birds were washed in tap-water and incubated at a temperature of 39° C. with daily changes of water. The larva usually hatched on the fifth day of incubation.

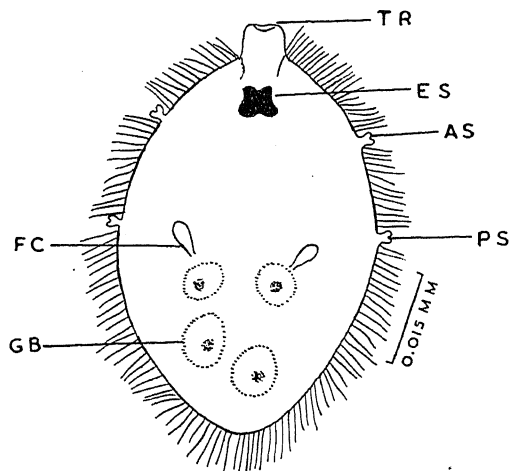


FIG. 1. Diagram of the Miracidium of *Echinochasmus bagulai*. AS, Anterior sensory papilla; ES, Eye spot; FC, Flame cell; GB, Germinal ball; PS, Posterior sensory papilla; TR, Terebratorium.

The oval ciliated miracidium (Figs. 1 and 2) measures 0.067 mm. in length and 0.048 mm. in breadth. A well-marked terebratorium (TR) occurs at the anterior end. Two lobes of closely approximated pigmented areas situated at a distance of 0.019 mm. from the anterior end represent the eye (ES). Rudiments of the eye appear as brown granules on the first day itself. Two pairs of sensory papillae could be observed; situated at 0.022 mm. (AS) and 0.036 mm. (PS) respectively from the anterior end. There are two flame cells (FC) which begin functioning on the second day. The posterior region of the miracidium is usually loaded with germinal balls (GB).

Previously Yamaguti<sup>2</sup> obtained the miracidium of *Echinochasmus rugosus*, by letting the eggs develop at room temperature when hatching



FIG. 2. Photomicrograph of the Miracidium of *E. bagulai*.

occurred on the twelfth day. Although details are lacking a gross similarity between the miracidia of *E. rugosus* and *E. bagulai* is apparent.

Department of Zoology, K. HANUMANTHA RAO.  
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## OCCURRENCE OF ENDOPOLYPOIDY IN THE HAUSTORIUM OF *SANTALUM ALBUM* LINN.

THE young host-less sandal seedling struggling to grow, on haustorisation with a host, has repeatedly been observed to exhibit a sudden and spectacular burst of vegetative activity<sup>1</sup>; the seedling puts on a "new look". This striking phenomenon which constitutes an important event in the life-history of the sandal, is an unmistakable indication of the fact that the seedling has launched on its parasitic career. In the course of our cyto- and histo-chemical

studies on the haustorial organ of sandal,<sup>2</sup> we found the occurrence of an increase in the number of chromosomes in the sections of haustoria.

Specimens of haustoria 2 mm. in diameter, apparently recently formed, were collected on 11th September 1960, from sandal saplings which had established a connection with *Cassia siamea*. The material was cream white in colour and soft in structure. Collections were made at intervals of an hour both day and night, over a period of 16 hours from 5 a.m. to 9 p.m. Collections after 9 a.m. could not be made. Immediately after collection, the material was fixed in 1:3 acetic alcohol for 24 hours. After washing the material with several changes of absolute alcohol, it was infiltrated through xylol-paraffin at 56° C. and finally embedded in paraffin. Sections of 10  $\mu$  thickness were microtomed (spencer) and were run through the schedule of Feulgen technique. The Hydrolysis was, however, carried out at 55° C. for 20 minutes. Finally, the sections were mounted in Canada balsam.

Working with root tips, the diploid number of chromosomes in *Santalum album* has been found to be 20.<sup>3,4</sup> So far, there appears to be no record of the chromosome number associated with the haustorium. A microscopic examination of our preparations has revealed that there is an increase in the number of the chromosomes in the haustoria. Forty chromosomes could be counted in many of the cells (Fig. 1). Com-

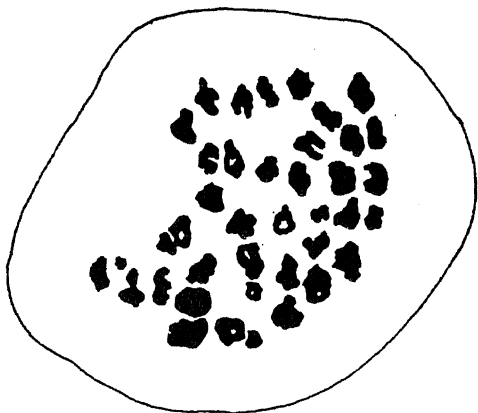


FIG. 1,  $\times 450$ .

pared with the root tip chromosomes prepared by squash Hæmatoxylin technique,<sup>5</sup> a two to five-fold increase in the size of the chromosomes of the haustoria, has been observed.

The spectacular increase in the rate of the growth of the sandal is to be related to the

increase in number and size of chromosomes. This is obviously a case of endopolyploidy—a phenomenon generally associated with most of the secretion glands. The Haustoria may be looked upon as a gland, particularly in view of our finding that the organ has been found to contain indole acetic acid and other related phyto hormones.<sup>6</sup>

A study of the autogenic, host, and other environmental factors which influence the initiation of the haustoria and the induction of endopolyploidy in the organ, is being pursued. Our grateful thanks are due to Dr. M. N. Ramaswamy for his kind and continued interest and encouragement. This work was carried out during his stewardship of this Laboratory. Our thanks are also due to Dr. P. S. Rao, the present Chief.

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February 7, 1962.

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#### ISOLATION OF *ALIESCHERIA BOYDII* SHEAR FROM HEATED INDIAN SOILS

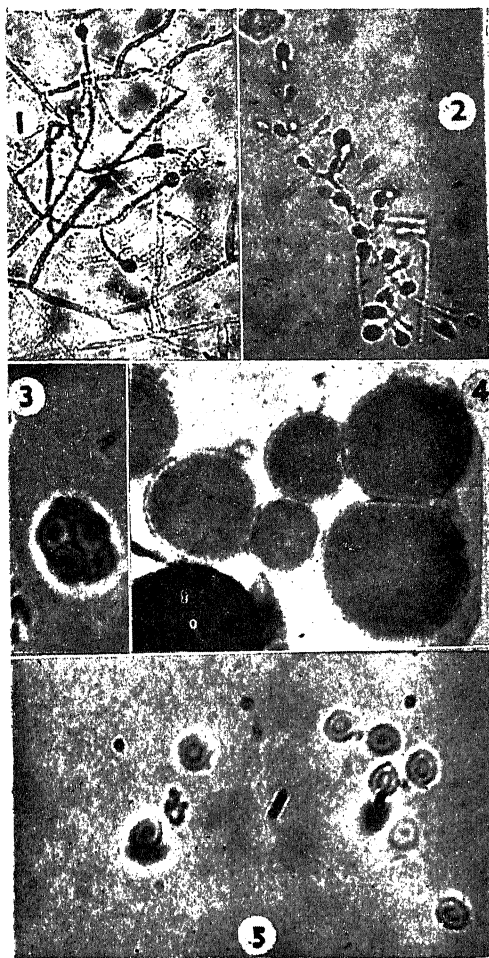
SHEAR in 1922 described an ascomycete obtained from a case of maduramycosis as *Ailescheria boydii*. Nearly 25 myceliar fungi, in addition to *Nocardia* spp., have been implicated in the clinical picture of maduramycosis, Madura foot or mycetoma but an imperfect fungus, *Monosporium apiospermum* Sacc., is regarded as a most frequent etiologic agent (Ajello, 1952; Conant *et al.*, 1954). Emmons (1944) established that *A. boydii* is the perfect stage of *M. apiospermum*, and this relationship has since been verified and found to be true (Emmons, 1950; Ajello, 1952). Though Madura foot is endemic in India, *A. boydii* is not reported from India (Ajello, 1952). Madura foot is frequently associated with trauma and is seen most frequently in persons who work barefoot in fields (Emmons, 1950). Such exogenous source of infection indicated that the pathogen is a saprophytic soil fungus. This has been confirmed by the recent isolation of *A. boydii* directly from soil from Kentucky,

U.S.A. (Ajello, 1961). It is noteworthy that the isolates from Madura foot are predominantly asexual *Monosporium* stage whereas, those from exogenous sources have more often produced the perithecia (Emmons, 1950; Ajello, 1952). This preliminary communication describes a strain of *A. boydii* obtained from Indian soils by a novel method which was devised by the authors primarily for isolating heat activated or heat-resistant soil fungi.

One gram of sifted top soil from Pulankinar and Andhiyur, Coimbatore District, Madras State, was suspended in 100 ml. sterile distilled water and exposed to 65° C. At 0, 15 minutes, 30 min., 1 hr., 2 hrs. and 4 hrs. exposures soil suspension was thoroughly shaken and 5 ml. suspension was withdrawn at each time interval; sample withdrawn at 0 time represented the untreated control. The soil suspension was plated out in Sabouraud's, Czapek's Oat meal or water agar in 1:2000 final dilution, and the plates were incubated at room temperature (32°–36° C.) for five days. From soil samples, plated out in duplicates, a cottony white fungus, identified as *Monosporium* sp., appeared from 2 hrs. heated soils. One of the isolates produced only conidia on dendroid conidiophores (Fig. 2) and chlamydospores whereas the other produced chlamydospores, conidia and fertile perithecia (Figs. 1, 4). The original as well as the subcultures of the latter produced conidia characteristic of *M. apiospermum* and perithecia resembling those of *A. boydii*. The fungus is described below.

Colony cotton white and turning to grey to buff. Reverse of the colony becomes dark grey with age and produced yellowish pigment in agar. Culture grows readily and unaltered at 37° C. Mycelia hyaline, septate, branched and about 3  $\mu$  thick. Conidiophores are long or short and indistinguishable from parent hyphae (Fig. 1). These bear terminally single, one-celled, hyaline and ovoid to pyriform conidia which measure 4.5 to 8  $\times$  5.5 to 10  $\mu$ . Branched conidiophores also occur. Rarely conidia are borne on 2–4 short terminal sterigmata. Coremia or sessile conidia on the sides of hyphae have not been observed. Chlamydospores are hyaline, spherical or various shaped. Cleistothecia are buff-coloured, sub-aerial, spherical 100–300  $\mu$ , soft and thin-walled. Cleistothecia contain numerous spherical asci which measure 8–10  $\mu$  in diam., are evanescent and contain 8 ascospores. A very large number of ascospores are extruded when mature cleistothecia are crushed. Ascospores are elliptical, one-celled and 3 to 4  $\times$  4 to 4.5  $\mu$  (Fig. 5). Newly formed ascospores have a faint

equatorial frill which is not visible on older spores. It is of interest to note that the fungus grew readily and produced fertile perithecia on moist sterile hay. Subcultures were obtained from cultures which were exposed to 60° C.



FIGS. 1–5. Fig. 1. Mycelia, conidiophores and conidia of  *Allescheria boydii*, the strain producing perithecia,  $\times$  275. Fig. 2. Conidiophores and conidia of a  *Monosporium* sp.,  $\times$  275. Fig. 3. Ascus containing young ascospores,  $\times$  835. Fig. 4. Cleistothecia,  $\times$  55. Fig. 5. Ascospores,  $\times$  970.

for 2 hrs. though conidia were not viable. Ascospores from 4 weeks old cultures did not germinate. Inasmuch as the germination requirements of the ascospores and chlamydospores are not known and the prolonged survival of conidia in soil is uncertain, abundantly produced ascospores might largely account for survival of the fungus in soil. Heat treatment of soil might have activated the dormant ascospores or merely permitted fungus growth due

to eradication of heat labile microbes and the resultant reduction of crowding and competition on the low dilution plates; or, both might have contributed to the growth of otherwise less frequently isolated fungi. Notwithstanding the numerous disadvantages this method has in common with other selective methods which are used in microbiology, it has proved very useful in selectively isolating ascomycetes from soil. Apparently, the propagules of these fungi are either heat-resisting, heat-activated or affected by chemical transformations due to heating.

Intraperitoneal injections of suspensions of conidia into white mice and rabbits have not produced any external symptoms. Animal inoculation is seldom of assistance in the absence of predisposing factors such as concomitant trauma and bacterial infection of the site of injury. Animals are not known to naturally suffer from maduramycosis. Further work on the fungus and its pathogenicity are in progress.

Grateful acknowledgement of award of a Senior Research Fellowship by the National Institute of Sciences of India to one of us (B. T. L.) and of appointment of Y. L. as Pool Officer, Council of Scientific and Industrial Research, Government of India, is made. We are thankful to Dr. T. S. Sadasivan, Director, University Botany Laboratory, for being generously helpful throughout.

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August 7, 1961.

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### AN INSTANCE OF BRAN LAYER INFLUENCING SEED DORMANCY IN RICE

THE exact causes of dormancy in rice varieties are not clearly understood. It is believed that the husk is in some way responsible for the dormancy as dehiscing brings about normal germination (Parija and Chalam, 1940) or considerably improves germination (Narayanan and Lakshmanan, 1952). While studying the germination of some promising cultures of *Thirinjavella*, a popular photosensitive local

variety which is noted for its dormancy, one culture No. 17 was found to behave different from others.

Seeds of two cultures 17 and 37 were tested for dormancy immediately after harvest. Both the cultures failed to germinate but on removal of the husk the seeds of culture 37 germinated normally. In culture 17 however it was observed that the embryo had swelled due to the absorption of water, but the usual splitting of the bran layer was not observed even after a week's time. This suggested that the removal of the bran layer might enable the embryo to come out.

Hulled seeds of culture 17 were soaked in water and another lot was put in moist soil. Half the quantity of seeds from both were taken out and the bran layer covering the embryo was removed carefully by means of a pointed needle without damaging the embryo. The seeds soaked in water were transferred to moist filter-paper while the other was put back in moist soil. Within 48 hours the seeds in which the bran layer was removed germinated whereas in those which were hulled only, few seeds germinated even after 7 days. When the bran layer was removed before soaking, peculiarly enough, the shoot emerged earlier in majority of the seeds on transfer to moist filter-paper. This phenomenon of rapid shoot emergence was also observed in the case of seeds of wild rice (*Oryza sativa* var. *spontanea*) when the bran layer was removed before soaking.

In another series, only the portion of the lemma above the embryo was removed retaining the palea and the remaining portion of the lemma intact, from seeds of both the cultures. These were then soaked in water for 12 hours. The bran layers from half of the quantity of seeds of the cultures were removed and these were then placed in moist sand. All the seeds of culture 37 germinated irrespective of the removal of the bran layer but in the case of culture 17 only seeds in which the bran layer was removed completely germinated.

Seeds of culture 17 were then subject to various treatments of removing palea and lemma and replacing the embryo in the lemma with or without the bran layer after soaking in water. Germination results of seeds under each of these treatments, A to H, are given in Table I.

Thus the bran layer would appear to have an inhibitory effect on the germination of culture 17 of *Thirinjavella*. Some of the tests show that this inhibitory effect is not exclusively of a physical nature. Further investigations are needed to elucidate this point. The behaviour

TABLE I  
Percentage of seeds of culture 17 germinated in the trial

Trial	Percentage of seeds germinated within 7 days
A	Nil
B	6
C	100
D	10
E	100
F	100
G	Nil
H	Nil

A=Unhulled, B=Hulled, C=Hulled and bran layer removed, D=Lemna above the embryo removed, E=Lemna and the bran layer above the embryo removed, F=Bran layer removed and then replaced in lemma with a cut, G=Bran layer removed and replaced in lemma without cut, H=Bran layer not removed and replaced in lemma without cut.

of seeds under treatment F in contrast to that under treatment G would indicate that lemma, too, has a role in suppressing germination.

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### THE LIVING SPERM OF LACCIFER LACCA

LITTLE is known about the structure and formation of the male germs of *Laccifer lacca* (Kerr). Misra<sup>1,2</sup> described each spermatozoon as "a filamentous structure with a screw-like head and a body tapering into a tail". It was interesting to elucidate as to how far the structural details of the spermatozoa observed under the phase contrast microscope would conform to the above description. The living spermatozoon is slender, thread-like and ranges in size from 0.42-0.45 mm. The anterior end for a distance of 0.016 mm. presents the appearance of a cork-screw, due to its being twisted 5-6 times along its longitudinal axis.

Under the phase contrast microscope, what appear to be the chromosomes, as judged from Feulgen preparations, seem to be arranged in

a helical fashion along the core of the sperm body (Figs. 1 and 2) as described by Hughes-Schrader in *Icerya*.<sup>3</sup>



FIGS. 1-3. Fig. 1. The screw-like anterior portion of the spermatozoon. Phase contrast,  $\times ca.$ , 2,250. Figs. 2-3. The distribution of the chromatin (CH) in the body (A) and tapering posterior end (B) of the sperm. Phase contrast,  $\times ca.$ , 2,250.

The sperm of the lac insect resembles that of *Icerya*. It has neither a head, nor a tail. This interesting organization is being further elucidated by a detailed study of spermatogenesis.

I am deeply indebted to Dr. M. S. Muthana, the Director of the Institute, for his constant encouragement and to Dr. M. K. Subramaniam of the Indian Institute of Science, Bangalore, for stimulating discussions on these problems.

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### INSECTS INTERCEPTED FROM SEEDS IMPORTED AND EXPORTED FOR PLANT INTRODUCTION WORK

IN the course of the activities of the Plant Introduction and Exploration Organisation of the Indian Agricultural Research Institute in respect of the importation of a variety of seeds from abroad and despatch of Indian materials to foreign countries, numerous packages of seeds are examined for the insect infestation by the Entomological Unit of this Organisation. During the period November 1958 to July 1960, as many as 4,663 seed samples ranging from a few seeds to 4 maunds but averaging about 4 ounces,

were examined and of these 73 (about 1.57%) samples showed evidence of having been infested at some stage. Of these 73 samples, however, 27 samples were imported from countries like Australia, Burma, China, Egypt, El Salvador (C. America), France, Greece, Israel, Italy, New Zealand, Trinidad and the U.S.S.R., while the rest of the samples were of Indian origin and intended for export to various countries.

The details of the interceptions made from the imported seeds are given in Table I and those from seeds of Indian origin and intended for export in Table II. The intercepted insects are mostly from the order Coleoptera, though some moths, psocids and eurytomids were also intercepted. The significant interceptions from imported seeds (*vide* Table I) are those of *Ephestia elutella* (Hb.) in wheat seeds imported from the Food and Agriculture Organisation, Rome, and of eurytomids from *Medicago denticulata* seeds imported from China, coriander seeds from the U.S.S.R. and *Petit trigonell* seeds from Italy. It is also interesting to note that from amongst the total number of interceptions, those of bruchids were the largest; these being as many as 29 or 39.7% of the total interceptions (*vide* Tables I and II).

TABLE I

*Insects intercepted from imported seeds*

Interception	Material	Stage and condition of insect recovered and results of quarantine	Source of material
<i>Coleoptera</i>			
<i>Aracerus fasciculatus</i> deG.	.. <i>Simarouba glauca</i>	All living stages	El Salvador
<i>Anthrenus vorax</i> W.	.. <i>Panicum coloratum</i>	Living adults	New Zealand
Bruchids	.. <i>Phaseolus vulgaris</i>	Eggs did not hatch	Burma
	<i>Glycine max</i>	do.	do.
	<i>Solanum melongena</i>	do.	Israel
	<i>Vicia sativa</i>	Dead adults	Greece
	<i>Vigna sinensis</i>	Eggs did not hatch	Burma
<i>Lasioderma serricorne</i> F.	.. <i>Cassia brewsteri</i>	All living stages	Australia
	Coriander	Dead adults	Egypt
<i>Rhizophorthera dominica</i> F.	.. Paddy	do.	Burma
<i>Sitophilus oryzae</i> L.	.. do.	do.	do.
	Wheat	do.	China
<i>Hymenoptera</i>			
<i>Systole albipennis</i> Wlk.	.. <i>Medicago denticulata</i>	Adults emerged during quarantine	do.
Eurytomids (under identification)	<i>Petit trigonell</i>	do.	Italy
	Coriander	Dead adults	U.S.S.R.
<i>Lepidoptera</i>			
<i>Ephestia elutella</i> (Hb.)	.. Wheat	Living larva reared to moth	Italy
Lepidopterous larva	.. <i>Mammæ americana</i>	Did not pupate, died	Trinidad
" pupa	.. Maize	Pupa died	France
<i>Psocoptera</i>			
<i>Liposcelis</i> sp.	.. Coriander	Living adults and nymphs	U.S.S.R.
	<i>Sesame blanc</i>	do.	Cambodia
	<i>Symphytum officinale</i>	do.	U.S.S.R.

TABLE II

Insects intercepted from seeds intended for export to foreign countries

Interception	Material
<i>Coleoptera</i>	
Bruchids	.. Cluster beans, <i>Dolichos biflorus</i> , Gram, <i>Lens culinaris</i> , Maize, Peas, <i>Phaseolus aureus</i> and <i>Acacia catechu</i>
<i>Gibbium psylloides</i> (Czenp.)	.. Chilli
<i>Oryzophilus surinamensis</i> L.	.. Sesamum and Sorghum
<i>Rhizopertha dominica</i> F.	.. Wheat
<i>Sitophilus oryzae</i> L.	.. Paddy and Sorghum
<i>Tribolium castaneum</i> (Hbst.)	.. Gram, Groundnut, Sesamum and Wheat
<i>Trogoderma granarium</i> Everts	.. Gram
Unidentified grub	.. Onion and <i>Sesamum palmi</i>
<i>Hemiptera</i>	
<i>Macropsus</i> sp.	.. <i>Corchorus capsularis</i>
<i>Hymenoptera</i>	
Pteromalids (under identification)	.. <i>Acacia catechu</i>
<i>Lepidoptera</i>	
<i>Chilo</i> sp.	.. Maize
<i>Sitotroga cerealella</i> (Ol.)	.. Paddy

These interceptions establish beyond doubt that small quantities of seeds also can serve as potential carriers for insects from one place to another. They may develop infestation either in the country of origin, during transit or even after reaching the country of destination. Since *Ephestia elutella* is quite commonly found in the shipholds, its interception in wheat seeds indicates the possibility of its infiltration into wheat during transit. The present case of interception is of special importance as *E. elutella*, a serious pest of stored tobacco, has not so far been recorded from India. Another important case is that of the eurytomid, *Systole albipennis* Wlk., from seeds of *Medicago denticulata*. Recently, Batra *et al.* (1959) recorded *S. albipennis* on fennel for the first time from India which would indicate that this insect is a case of recent introduction into India.

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### SEED CUTICLES IN SOME MODERN CYCADS

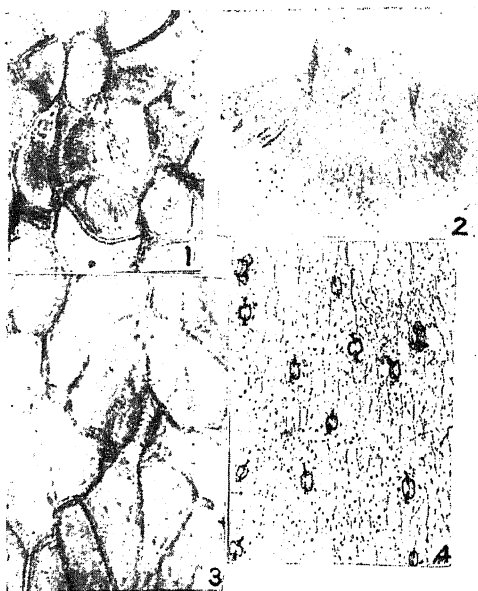
CUTICULAR study has been made of the seeds of eighteen species belonging to eight genera of the Cycadales, viz., *Cycas revoluta* Thumb., *C. pectinata*, Griff., *C. yeddomei* Dyer, *C. rumphii* Miq., *C. circinalis* Linn.; *Encephalartos eximius* Verdoorn, *E. villosus* (Garten) Lem., *E. hildebrandtii* Braun *et* Bouch, *E. altensteinii* Lehmann, *E. umbelusiensis* Dyer, *M. reidlei* (Gaud.) C. A. Gardner; *Ceratozamia mexicana* Brong.; *Stangeria eriopus* Nash; *Microcycas calocoma*

(Miq.) A.D.C. and *Zamia pumila* Regal, Revis. Suitable maceration of a well-formed seed yields at least seven categories of resistant membranes, viz., outer and inner cuticles of integument, nucellar cuticle, megaspore membrane and a variable number of egg and embryo membranes. The megaspore membrane is double-layered at least in some cases, e.g., *Cycas beddomei*, and shows an inner layer with vague polygonal outlines representing impressions of the outermost layer of endosperm cells and an outer granular membrane. The embryo membrane may be seen continued inside the egg membrane. Here it shows reticulate marks representing the outlines of suspensor cells. Stomata are generally present only in the outer cuticle of integument (see Fig. 1) but even here they are absent in *Cycas rumphii*, *C. beddomei*, *C. pectinata*, *C. circinalis* and *Microcycas calocoma*. The largest frequency of stomata is found in *Ceratozamia mexicana* and the smallest in *Dioon edule*. Their distribution and orientation are usually irregular but in *Zamia pumila* they are generally arranged in longitudinal rows. Chamberlain<sup>1</sup> could not observe stomata on the outer surface of integument in *Dioon edule* but we find a few stomata restricted to the chalazal end of its outer cuticle of integument.

Seeds of *Zamia pumila* and *Cycas pectinata* have stomata on their nucellar surface as well (see Fig. 3). The nucellar cuticle of *Cycas revoluta* shows isolated short hyaline cells between larger surface cells and these sometimes show a faint central partition. Such cells possibly represent divided or undivided guard cell-mother cells. The occurrence of nucellar stomata was first recorded in *Zamia floridana* by Shapiro<sup>2</sup> but he failed to find them in *Cycas*. The nucellar stomata of *Z. pumila* are similar



to those of *Z. floridana* but unlike the condition in *Z. floridana* they are here restricted to the basal half of the nucellus, while in *C. pectinata* they are found towards the micropylar end.



FIGS. 1-4. Fig. 1. *Stangeria eriopus*. Stoma from outer cuticle of integument,  $\times 225$ . Fig. 2. *Encephalartos eximius*. Embryo membrane showing a number of stomata (dark spots),  $\times 9$ . Fig. 3. *Cycas pectinata*. A nucellar stoma,  $\times 286$ . Fig. 4. *Cycas revoluta*. Embryo membrane showing stomata,  $\times 68$ .

A remarkable feature of the Cycadean seeds is the presence of well-developed stomata in their enclosed embryos. Maceration of embryos, dissected out of seeds of *Cycas revoluta*, *Encephalartos eximius*, *Macrozamia spiralis*, *M. reidleyi* and *Stangeria eriopus* yields cuticles showing clear cell outlines and numerous stomata (see Figs. 2 and 4). In *Cycas revoluta* bicelled hairs or their bases are also seen. The embryo cuticle of the hypocotyl region is tough but that of the cotyledons and the stem tip is more delicate. Stomata are usually confined to the hypocotyl region or towards the bases of the cotyledons. Their orientation is generally longitudinal but some may be obliquely or horizontally placed.

The various cuticles of seeds, sporangia and leaflets of a number of Cycadales have been worked out in detail and a comprehensive paper embodying the results will shortly be published elsewhere.

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# VARIETAL RESISTANCE IN *BAJRI* [*Pennisetum typhoides* (BURM) S. AND H.] TO ERGOT [*Claviceps* *microcephala* (WALLR.) TUL.]

IN an earlier note, Shinde and Bhide<sup>1</sup> (1958) had reported that all the 28 varieties and selections of *bajri* tested by them against ergot proved highly susceptible. In the present work, 144 cultures of *bajri* comprising varieties, strains and selections, indigenous and exotic, maintained at the Agricultural Research Station, Niphad, in Nasik District of Maharashtra State, were tested for their reaction to ergot under conditions of an artificial epiphytotic in a glass-house at Poona, during 1960. Seeds were sown in 9-inch earthen pots filled with steamed soil and five plants were maintained per pot. When earheads had emerged they were sprayed with an aqueous suspension of spores of the sphaecelial stage of *Claviceps microcephala*, of proved pathogenicity, that had been maintained in culture; 3-4 sprayings were given in all at daily intervals. Infection appeared in a week's time and progressed rapidly. Observations on presence, number and size of sclerotia formed per ear were recorded 7 weeks after inoculation.

All the 144 cultures of *bajri* proved susceptible to ergot; however, in some cultures very few, small sclerotia were formed on an ear. In general, the awned varieties were much less susceptible. The following cultures showed some degree of resistance as judged by the number and size of sclerotia in comparison to the highly susceptible ones: PT-838-6, P-350, PT-833-4, Co.-2, Australian 21-65, 168-A, R.S.K., S-530 (Punjab) awned, Co-3 (Coimbatore), Bajra 2-L (Kanpur), Savargaon M-5 A-G-B, A.K. 297  $\times$  Amreli A.G.B., 179-G-4, Tharparkar (awned), A-1-3 and Palanpur (awned). There were less than 5 sclerotia per ear in these cultures as against 10 and more in the rest; also, the sclerotia measured about 2 mm. as against 3 mm. and over in the highly susceptible cultures. In some susceptible cultures the sclerotia were as long as 10 mm.

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Poona, August 9, 1961.

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## REVIEWS

**Differentiation and Integration.** By H. A. Thurston. (Blackie and Son Ltd., London, Glasgow), 1961. Pp. x + 148. Price 30 sh. net.

Anyone invited to review a new text on Calculus is likely to exclaim: "Good gracious, another one!" There are so many of them on the market, most of them just repeating what others have already said and occasionally trying to justify the outrageous opinion that rigour must remain the privilege of a few mature minds!

Whoever happens to read Professor Thurston's text on Differentiation and Integration will immediately feel that there is a most welcome addition to the existing literature. Proposing a quite simple, yet an altogether rigorous, treatment of the foundations of Analysis, this little book must be warmly recommended to all Mathematics teachers. The reviewer was particularly delighted to read the beautiful chapter on limits. The author is not afraid—but why should he be?—of basing the concept of limit on topological notions. This is undoubtedly not only the most logical, but also the most elementary, method. Extremely interesting also are the developments devoted to partial differentiation. There is no one who has not experienced the dangerous ambiguity of the usual notations. However the one proposed by the author may become impractical when a great many indices are called into play. Instead of writing  $f_{12}$  (for  $\partial^2 f / \partial x \partial y$ ) many nowadays write  $\delta_{12}f$ .

Shall I end this review with a slight criticism? Why call "antiderivative" what everybody—or almost—is satisfied to call "primitive"?

Professor Thurston's new text is undoubtedly an important contribution to a better teaching of Mathematics.

C. RACINE.

**The Indian Ephemeris and Nautical Almanac, 1962.** (Regional Meteorological Centre, Alipore, Calcutta-27), 1961. Pp. 460. Price Rs. 14.

The present issue of the Ephemeris for 1962, which is the fifth in the series, maintains the same high standard as that of the previous years, and contains an addition of four new tables indicated on page v of the Preface. Of these, the last one relating to the local circumstances of occultations of bright stars and planets

visible in India had been omitted from the Issue for 1961 with the hope that it would be possible to present the information in an improved form in later years. This promise has been fulfilled in this Issue, and the related table contains local circumstances of two occultations of Saturn on April 27, 1962, and August 14, 1962, the first as seen from Shillong, and the second from Delhi and Srinagar. On the same page, viz., p. 307, there is a special mention of an "appulse" of Venus and the star Spica. This unusual term might well have been replaced by stating that there is going to be a very near conjunction of Venus with Spica. The first two of the new tables provide the Ephemeris for physical observations of the Sun and the Moon, and their value is enhanced by the Explanation relating to them given on p. 452. But the third new table concerning the centre of mass of the solar system lacks an Explanation devoted to it, and we hope this will be supplied in future years.

While reviewing the very first Issue of the Almanac, we had occasion to mention the urgent necessity of our country taking an active part in the International agreement regarding exchange of fundamental data necessary for the preparation of the several tables of an Ephemeris. It is not clear from the remarks on page v of the Preface to the present issue, whether any steps have so far been taken towards this end. A reference is made to arrangements of exchange relations, and to the large number of data supplied to us by several Observatories according to such an arrangement, but there is no reference to any kind of data supplied by us to other countries. We wish to reinforce our original plea for the immediate setting up of an Astronomical Observatory of the highest class in the country, and thereby building a centre of astronomical studies.

B. S. M.

**Topology.** By John G. Hocking and Gail S. Young. (Addison Wesley Pub. Co. Inc.), 1961. Pp. x + 374. Price \$ 9.75.

This book on Topology is a welcome addition to the books suitable for a first course (or first study). The first principles are clearly developed, with interesting examples, in the first four chapters. Many important results find

their natural place here, including a treatment of uniform spaces, continua, dimension theory, and homotopy theory; arcwise connected sets, mappings of the unit interval, indecomposable continua, the fundamental group of a space, and some knots are all covered in this portion.

The second half, consisting of four chapters leads to the homology theories. Triangulation, simplicial homology, cohomology, Cech homology, and Vietoris homology are all treated. The more general homology theories are treated in brief, while the simplicial theory is naturally treated at length, giving a typical, and classical homology theory.

Many illuminating remarks and comments in the course of the text, a reference list and index of terms, make the book a useful one for all those who wish to study topology seriously, and get some idea of its ramifications and power. The book would be a popular one in our University centres where topology is being introduced as a new subject of study.

V. S. KRISHNAN.

#### Advances in Enzymology, Vols. 22 and 23.

Edited by F. F. Nord. (Interscience Publishers, Inc., New York and London). Vol. 22: 1960. Pp. v + 567. Price \$14.00. Vol. 23: 1961. Pp. v + 557. Price \$15.50.

Research work in the field of enzymes has been expanding so rapidly that one eagerly looks forward every year to the series publication of the *Advances in Enzymology* for an authoritative account of the different aspects of its development. The two volumes under review, contain nine articles each on diverse topics of current interest to biochemists.

Volume 22 opens with an article by J. R. S. Fincham wherein he has discussed the genetically controlled differences in enzyme activity, which is of great interest to biochemists from several points of view, such as the mechanism of genetic control of enzyme formation and specificity as also the nature of the relationship between genetic loci and specific enzymes. D. E. Koshland Jr. writes the next article on the active site of enzyme action.

H. O. Halvorson has reviewed the present status of the subject of "the induced synthesis of proteins" and has endeavoured to focus attention on the biochemical aspects underlying the mechanism of adaptive response in enzyme formation. He has also presented a model providing a basis for explaining the kinetics of induced enzyme synthesis. The central theme of the mechanism of induction according to him

is the existence of ribosomal templates containing pre-enzyme, whose conversion to enzyme is activated by the inducer. J. Baddiley and N. A. Hughes have discussed in the next article the different aspects of the synthesis of nucleotide coenzymes with particular reference to the mixed anhydride method, the carbodiimide and related methods and the phosphoramidate method.

Among the other reviews in this volume, mention may be made of (i) The synthesis and hydrolysis of sulphate esters by A. B. Roy; (ii) The biochemistry of sulfonium compounds by S. K. Shapiro and F. Schlenk; (iii) The Biosynthesis of Cholesterol by G. Popjack and J. W. Cornforth and (iv) Coenzyme binding by S. Shifrin and N. O. Kaplan. In view of the ready availability of highly purified enzymes, many research workers in recent years have investigated the nature of the binding sites of the various coenzymes to the appropriate protein and the last-named authors have dealt extensively with the binding of pyridine coenzymes flavin coenzymes, pyridoxal phosphate and thiamine pyrophosphate.

In Volume 23 the first two articles are (i) possible polypeptide configurations of protein from the view-point of internal rotation potential and (ii) the denaturation and inactivation of enzyme proteins. Evidence has been presented to prove that the folded or helical forms or a specific combination of these forms correspond to the characteristic secondary structure of proteins and that this is responsible for their specific function.

J. A. Christiansen in his article on "Periodic enzymic reactions and their possible applications" deals with the concept of periodic chemical and enzymic reactions to explain such phenomena as heart beat in living organisms, while P. Desnuelle has summarised in his article on Pancreatic Lipase, the purification procedure, and the mode of action of the enzyme. In view of the recent finding that pancreatic lipase acts exclusively on emulsified esters, casting serious doubts on earlier experiments using soluble esters, the latter article is bound to evoke considerable interest.

There is, for the first time, an exhaustive report by I. Mandl on the two lesser known but nevertheless highly important enzymes, collagenase and elastase. R. Lemberg in his article on "Cytochromes of group A' and their prosthetic groups" describes in great detail on what is known about the cytochromes of group A which function in the terminal electron transport in biological exudations.

The importance of the glyoxylate cycle as a by-pass of kreb's cycle, effectively replacing the tricarboxylic acid cycle intermediates drained away for the synthetic reactions, has been discussed by H. L. Kornberg and S. R. Elsdon in their article entitled "The metabolism of 2-carbon compounds by microorganisms". The remaining two articles deal with the mechanism of synthesis of adenosine triphosphate and with the discovery and chemistry of mevalonic acid.

P. S. SARMA.

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**Progress in Organic Chemistry, Vol. 5.** Edited by J. W. Cook and W. Carruthers. (Butterworths, London), 1961. Pp. viii + 172. Price 50 sh.

The appearance of the fifth volume in the series "Progress in Organic Chemistry" is to be welcomed with much interest since it provides—in the tradition of the earlier volumes—critical and brief surveys of topics of great interest to natural products chemists as well as physical organic chemists. The volume under review carries five chapters dealing with: homolytic oxidation processes; hydroxylation of phenols; chemistry of dextran; chemistry of the higher terpenoids and the chemistry of tropylium compounds.

In recent years it has become the practice of many eminent organic chemists to discuss extensively one and the same contribution by their schools in more than one review journal. This results in perhaps greater accessibility of the review to reach workers in many different countries but produces little new material from one review to another. An example to substantiate this is the chapter on Tropylium derivatives by Professor Nozoe who has already covered much of this material in *Non-benzenoid Aromatic Compounds* edited by D. Ginsburg. To a smaller extent the criticism can be made of the chapter on homolytic oxidations. However, Professor Waters' section is one of the most readable and provocative and presents in very lucid style the extent of work that is already known and the vast amount of work that still awaits critical investigation. In his own words, "it may well be that the subject-matter of this chapter may need substantial revision in a few years' time". A number of physical organic chemistry text-books cite the relative selectivity in atomic chlorination as evidence for the relative stability of primary, secondary and tertiary radicals. Prof. Waters' chapter clearly states how such a difference will vanish with

a rise in temperature of the reaction. It is interesting to note that Prof. Waters admits of the possibility of an ionic mechanism for the N-demethylation of dimethylaniline by benzoylperoxide. Little is known as yet of the similar action of potassium ferricyanide on tertiary amines. Concerning the oxidation of alcohols by chromic acid or by aluminium alkoxides, Waters states these reactions involve cyclic transition complexes which leave the direction of flow of electrons indeterminate. One would be led to believe that the deuterium labelled work of Prof. Westheimer and the work of Prof. S. V. Anantakrishnan with aliphatic alcohols clearly emphasise hydride abstraction in chromic acid oxidation while the work of Prof. Doering has established the hydride shift in Meerwein-Ponndorf-Verley reduction-oxidations. In the light of this, it is difficult to conceive of reversal of the direction of flow of electrons.

The section by Prof. Loudon describes the application of a wide variety of reagents employed to hydroxylate phenols. Fremy's salt, Fenton's reagent, persulphate, alkaline hydrogen peroxide are among the reagents mentioned. The contribution of Prof. Seshadri's school in the elucidation of structures of flavonols and depsides by the application of the Dakin reaction and Elbs reaction is well emphasised.

The structure, biosynthesis and polymeric properties of dextran are dealt with in the third section by Dr. Ricketts. The developments in this field since 1950 are presented. The application of infra-red, optical rotation and periodate oxidations in establishing the nature of branching in dextran is described.

Barltrop and Rogers review the recent developments in the chemistry of the higher terpenoids. This chapter carries a very large and extremely interesting section on the biosynthesis of terpenoid derivatives. The role of acetate, mevalonic acid, isopentenylpyrophosphate, geranyl and farnesylpyrophosphates as precursors in the building up of squalene is extensively discussed. This section offers stimulating reading.

Professor Nozoe's chapter provides details of the Wisconsin and Zurich syntheses of the complex molecule Colchicine, some photochemical transformations of tropylium derivatives and the chemistry of heptafulvene. The growth of literature in this field in the past decade has been in no small measure to the activities of Prof. Nozoe's school and before too long he may have to write again much newer and fascinating chemistry in the same field.

Volume 5 of Progress in Organic chemistry is a valuable addition to organic chemical literature in the topics covered.

B. S. THYAGARAJAN.

**Fatty Acids: Their Chemistry, Properties, Production and Uses.** Parts 1 and 2. Edited by K. S. Markley. Second completely revised and augmented edition. (Fats and Oils: A series of Monographs on the Chemistry and Technology of Fats, Oils and Related Subjects.) (Interscience Publishers, Inc., New York). Price: Part I—\$22.50; Part II—\$27.50.

Few groups of natural products have so much chemical, biological and industrial interest and importance as fats and fatty acids, which fact is fully borne out by the series under review. The first edition of *Fatty Acids* was entirely written by K. S. Markley in 1947 as a single volume. But since then the progress in the field has been so rapid and the work so voluminous that in order to make it up-to-date it has been necessary to bring out the same work in four separate volumes written by different specialists in the field.

Part I has chapters by Markley on Historical and General (22 pages), Nomenclature, Classification and Description of Individual Acids (226 pages) and on Isomerism (38 pages); by Robert T. Oconnor on X-Ray Diffraction and Polymorphism (94 pages) and on Spectral Properties (120 pages) and by W. S. Singleton on Properties of Liquid State (110 pages) and on Solution Properties (70 pages). The chapters of Part 2 consist of Salts of Fatty Acids (43 pages), Esters and Esterification (228 pages) and Hydrogenation (120 pages) by Markley himself; of Dehydration, Pyrolysis and Polymerization (88 pages) and Halogenation, Dehalogenation and Dehydration (114 pages) by Norman O. V. Sonntag and of Chemical Oxidation (80 pages) and Oxidation by Atmospheric Oxygen (58 pages) by Daniel Swern.

It is quite clear that the subjects covered in the two parts are quite diverse. Even the modern tools of organic chemists, like the physical methods, are adequately dealt with as far as the fatty acids are concerned. Thus X-ray diffraction, ultraviolet, visible, infra-red and micro-wave spectroscopy and nuclear magnetic resonance are discussed and even the estimation of *trans*-isomer contents by infra-red spectroscopy has been described.

The surveys by Markley of individual acids, of salts of acids, of esterification and of hydrogenation in four distinct chapters are masterly

both from academic and industrial points of view. For example, under salts of fatty acids he not only covers the theoretical aspects, but also describes in detail how these are used industrially in millions of pounds as driers, as gelling agents in the manufacture of greases, as coatings in rubber and plastics industries, for waterproofing and as fungicides and herbicides. Similarly under hydrogenation he elaborately discusses the various methods and conditions, as well as the theoretical aspects, like the mechanisms of hydrogenation.

In short both parts of this enlarged edition of *Fatty Acids* consist of most thorough and masterly surveys of the relevant literature and will prove indispensable to academic and technological institutions, as well as to the industries concerned. In addition, the workers will eagerly look forward to the appearance of the other two parts (Parts 3 and 4).

J. GANGULY.

**Diazo and Azo Chemistry—Aliphatic and Aromatic Compounds.** (Translated by Harry E. Nursten). By Heinrich Zollinger. (Interscience Publishers, Inc., New York), 1961. Pp. 444. Price \$16.50.

Since the publication of *Chemie der Azofarbstoffe* by H. Zollinger the need for an English translation was keenly felt by organic chemists and the present English translation (in part) by H. E. Nursten of a revised edition amply justifies the effort. The inclusion in the book of two chapters on the chemistry of aliphatic azo compounds and the various reactions of aromatic diazonium ions unconnected with azo dyestuffs is most appropriate and the removal of the sections on technology of azo dyes and dyeing has narrowed the scope of the book only to a very limited extent. In spite of the wide differences in the properties of aliphatic and aromatic diazonium compounds the side-by-side treatment of the subject in the various chapters of the book tends to show the structural similarity between them. The book begins with the various methods of preparation of diazo compounds, both aliphatic and aromatic and is followed by a discussion on the mechanism of diazotisation and diazo equilibria. The wide variety of reactions which the diazoalkanes are capable of undergoing, their synthetic applications and potentialities and the reaction mechanism of aliphatic diazo compounds are elegantly presented; their inclusion makes this book a very valuable supplement to *The Chemistry of Synthetic Dyes*, Vol. I, by K. Venkataraman and *The Aromatic Diazo-Compounds* by

Saunders. The concluding chapters in the book deal with the decomposition of aromatic and aliphatic azo compounds, the light absorption of azo compounds and the chemistry of the metal complexes of azo dyes. Over 2,500 references to original literature and patents are listed in alphabetical order at the end of the book together with author and subject indices. Reaction mechanism and kinetics are given utmost importance throughout the treatment of the subject and the explanation of the underlying fundamental considerations at relevant places makes very pleasant reading. This approach, however, has not in any way adversely coloured the systematic and comprehensive account of the methods of preparation and properties of diazo compounds.

This book should be a valuable acquisition to the personal library of one interested in any aspect of the chemistry of aromatic or aliphatic azo compounds.

M. K. UNNI.

*International Review of Tropical Medicine*, Vol. I. Edited by David Richard and Lincicome. (Academic Press, New York; India: Asia Publishing House, Bombay-1), 1961. Pp. xii + 300.

The significant advance in recent times, in the fields of medicine and public health, has been the realization that the 'Tropical Medicine' once considered to be a specialized distinct entity, can no longer be limited to any particular group of diseases prevent in the tropics. In these days of rapid intercommunications and fast travel, the problems of health are international.

*The International Review of Tropical Medicine* is in the editors words "dedicated to this international concept of world medicine and focuses its attention on 'Tropical areas' of the earth because, here, perhaps, are the frontiers of the practice and Science of Medicine."

The first volume of this series has selected for presentation three widely prevalent diseases. The articles on 'A critical appraisal of the present position of Leprosy', 'The multiple facets of *Entamoeba histolytica* infection' and the 'Outline of xerophthalmia' are comprehensive surveys and focus the attention on the need for reorienting our outlook for control and eradication of these disorders.

"Immunochemical staining with the fluorescent antibody" describes in detail the ingenious and extremely useful technique of the labelling of antibodies. The principle involved, technical

considerations and the application of fluorescent antibody methods to viruses, Rickettsia, bacteria, fungi and spirochaetes, are lucidly presented. The potential usefulness of this tool for investigations in protozoology and helminthology opens a very fascinating field of enquiry.

The diagnosis and control of Kyasanur Forest disease is a typical example of the need for interdisciplinary and international co-operation in medical research. The chapter on "Ticks and Tick borne diseases" gives many more examples of brilliant achievements by such co-operative studies and emphasizes the unitary concept of world Health.

"Patrick Manson as a parasitologist", is an inspiring biographical sketch of this famous personality and gives an account of Manson's pioneer work in China.

M. SIRSI.

*Anthropology in India*. By L. A. Krishna Iyer and L. K. Bala Ratnam. (Bombay: Bharatiya Vidya Bhavan), 1961. Pp. xii + 257. Price Rs. 10-00.

Mr. Iyer is well known for his contributions to the ethnography of Coorg and Travancore, but this book, written in collaboration with his son, is disappointing. It contains only one chapter on anthropological research in India, and that too is a catalogue of names and titles, marred by inaccuracies and omissions. Thus, to give but two examples, it was not Risley but Buchanon who was the first person to write upon the tribes and castes of Bengal; and Man published his book on the Andamanese in 1882, not in 1932.

Its misleading title apart, the book is not 'the first comprehensive publication covering the whole field, since the days of Risley and L. K. A. Iyer, the authors' 'claim' to that effect notwithstanding. Their book is very similar in conception and plan to Majumdar's *Races and Cultures of India* which is known to our authors as they have mentioned it in the bibliography.

Our authors would have put Indianists under heavy debt if they had provided a compendium of ethnographic materials from South India. But in their desire to produce a 'comprehensive' survey in 232 pages, they have succeeded only in turning out a scrap book. Take Caste. They do not add to what Majumdar wrote about caste in *Races and Cultures*, or to what Srinivas has said on it in his various papers. They offer no specific data on the caste situation in the South. The same is more or less true of all other chapters. The authors' knowledge is not up-to-date on several subjects: witness their

treatment of prehistory and prehistoric man. They misquote; and quote at several places without giving due credits: The classification of tribes given on page 51 is the same as was drawn up by Elwin years ago. One has the feeling that the authors are hardly aware that anthropology has long since ceased to be a pursuit for amateurs.

T. N. MADAN.

**Elementary Fluid Mechanics** (4th Edition). By John K. Vennard. (John Wiley and Sons, New York-16, N.Y.; India: Asia Publishing House, Bombay-1), 1961. Pp. xiv + 570. Price \$ 7.95.

This is a very lucidly written book intended for the beginner in undergraduate course. Hence the emphasis has been more on physical concepts rather than on mathematical manipulations.

It contains 13 chapters and 10 appendices. The first seven chapters deal with fundamentals of fluid mechanics, covering properties of fluids, fluid statics, kinematics of fluid motion, flow of incompressible and compressible ideal fluids, impulse-momentum principle, real fluids, etc. A small chapter deals with similitude and dimensional analysis. Fluid flow in pipes, liquid flow in open channels occupy two important chapters. Chapter 11 treats fluid measurements. Some ideas about elementary hydrodynamics, and fluid flow about immersed objects are covered in the last two chapters. Some information about physical properties of water, dimensions, areas and volumes and brief ideas about wave velocities, cavitation, turbulent pipe flow are contained in the appendices.

A special feature of this book is its collection of over a thousand problems and numerous references at the ends of chapters, which makes it very useful to the student as well as to the teacher. It can be recommended to be used as a text-book in undergraduate course in Engineering.

K. T. S.

**A Dictionary of Named Effects and Laws in Chemistry, Physics and Mathematics.** By D. W. G. Ballentyne and L. E. Q. Walker. (Chapman and Hall, London, W.C. 2; India: Asia Publishing House, Bombay-1), 1961. Pp. v + 234. Price 30 sh.

This glossary has been found to be a useful book of ready reference not only by students but by the general scientific reader. In the second edition more than 150 new definitions

have been added. A compilation of this kind can never be exhaustive. Still all well-known Effects of importance have been included though not accurately defined in some cases. As a test the reviewer looked for a dozen Effects, and the only one he missed to find was the "Lossev Effect".

#### Books Received

From: Academic Press, New York and London, India: Asia Publishing House, Bombay-1:  
**Toxicology—Mechanisms and Analytical Methods** (Vol. II). By C. P. Stewart and A. Stolman, 1961. Pp. xvi + 921. Price \$ 25.00.

**Quantum Theory, I. Elements.** Edited by D. R. Bates, 1961. Pp. xv + 447. Price \$ 10.00.  
**Quantitative Organic Microanalysis** (2nd Edition). Al. Steyermark, 1961. Pp. xvii + 665. Price \$ 16.50.

**Physics of the Aurora and Airglow** (Vol. 2). By J. W. Chamberlain, 1961. Pp. xviii + 704. Price \$ 16.50.

**Chemical Processing of Reactor Fuels** (Vol. I). Edited by J. F. Flagg. Pp. xi + 530. Price \$ 17.50.

**Sexuality and the Genetics of Bacteria.** By F. Jacob and W. L. Wollman, 1961. Pp. xv + 374. Price \$ 10.00.

**Plastic Flow and Fracture in Solids.** By T. Y. Thomas, 1961. Pp. x + 267. Price \$ 8.50.

From: The Cambridge University Press, London, N.W. 1:

**Modern Magnetism** (4th Edition). By L. F. Bates, 1961. Pp. xii + 514. Price 22 sh. 6 d.

**The Principles of Chemical Equilibrium.** By K. Denbigh, 1961. Pp. xxi + 491. Price 18 sh. 6 d.

**Introduction to Animal Virology.** By A. P. Waterson, 1961. Pp. viii + 96. Price 22 sh. 6 d.

**On Growth and Form.** Edited by J. T. Bonner, 1961. Pp. xiv + 345. Price 32 sh. 6 d.

From: Interscience Pub. Inc., New York:

**Submicrogram Experimentation.** Edited by N. D. Cheronis, 1961. Pp. viii + 351. Price \$ 10.75.

**Advances in Textile Proceeding** (Vol. 1). By J. E. Lynn. (J. J. Press), 1961. Pp. xii + 379. Price \$ 14.00.

**Library Science and Documentation** (Vol. II)—**Punch-card Methods in Research and Documentation with Special Reference to Biology.** Edited by J. H. Shera. Pp. xiv + 274. Price \$ 9.50.

**Advances in Spectroscopy** (Vol. II). Edited by H. W. Thompson, 1961. Pp. xi + 483. Price \$ 13.00.

## SCIENCE NOTES AND NEWS

### Award of Research Degree

Karnatak University has awarded the Ph.D. Degree to Shri A. P. Walvekar and Shri V. V. Bagalkoti for their theses entitled "Spectroscopy : Transition Probabilities of Band Systems of BaO and BO" and "Studies in Spectroscopy : Rotational Temperatures in Discharge under External Heating" respectively.

### Federation Internationale de Documentation

The Federation Internationale de Documentation (FID), 7 Hofweg, The Hague, Netherlands, is preparing with financial collaboration of the National Science Foundation in Washington D.C., a comprehensive inventory of abstracting services covering the fields of science, technology and social sciences.

The study will probably take two years. The data will be collected by means of a questionnaire to be distributed at the beginning of February 1962. Besides information about nature and scope of each abstracting service, the questionnaire will elicit detailed information on such topics as number of periodicals consulted during a year, the existence of a reproduction service, and whether translations can be made.

On completion of this project, FID plans to establish an international information centre, the first object being to give supplementary information on data revealed by the questionnaire. The Federation would welcome the co-operation and help of everyone concerned in this inventory of abstracting services.

### Seventh Congress of Theoretical and Applied Mechanics

The Indian Society of Theoretical and Applied Mechanics, IIT, Kharagpur, India, held its Seventh Congress from December 23 to 26, 1961, at the Indian Institute of Technology, Bombay. Over 200 delegates and members from India and abroad attended the Congress.

About 90 papers divided under the following main sections were presented and discussed at the sectional meetings : (i) Elasticity and Plasticity, (ii) Fluid Mechanics, (iii) Vibration and Lubrication Studies, (iv) Thermodynamics and Heat Transfer and (v) Statistics and Computation.

Half-hour addresses were delivered by Y. V. G. Acharya, R. Ballabh, L. Collatz, J. N. Kapur,

E. A. Kearsley, H. Langhaar, G. N. Meshcheryakov, I. E. Tarapov and T. Wah.

The Eighth Congress will be held in December 1962, at M.B.M. Engineering College, Jodhpur, India.

### Volatile Carbonyls in the Flavour Substances of Onion (*Allium cepa*)

When the volatile substances in the onion were studied, two unknown carbonyl compounds were found in addition to acetaldehyde and propionaldehyde. One of the unknown substances was chemically characterized as 2-methyl-2-pentenal. The other carbonyl compound, which was present in very small amounts, has not yet been identified. On the basis of its UV-spectrum and behaviour on the paper chromatogram, it may be a saturated aldehyde. 2-Methyl-2-pentenal is formed enzymatically in crushed onion. The only alcohols found were methanol and ethanol.—(*Acta Chem. Scan.*, 1961, 15, 1280.)

### A New Strain of Jute

A new strain of the Tossa (*C. olitorius*) variety of jute which can be sown as early as March simultaneously with the White (*C. capsularis*) variety has been successfully evolved by the Jute Agricultural Research Institute of the Indian Central Jute Committee. One aim of the improvement sought by the Institute in its Tossa breeding work has been to evolve a type that can be sown early without the risk of premature flowering so that after the harvest of jute the land can be released in time for the cultivation of a paddy crop.

The aim has largely been realised by successfully crossing an improved Tossa variety with another of the exotic type. The hybrid retains all the known characteristics of Tossa while adding one more—that of growing about the same time of the season as White jute.

### Use of Calcium-47 for Research in Medicine

For quite some time it had been assumed that calcium-47 might offer a valuable means for research in the physiology and pathology of human bones. Apart from their practical value in clinical medicine the result of such research would also be of considerable importance for the understanding of the behaviour of other



bone-seeking elements such as strontium-90. Limited availability of this isotope and its prohibitively high price stood in the way of promoting research in this direction. Thanks to the special programme embarked by the International Atomic Energy Agency as early as 1958 aimed at cheaper and improved methods of production, Calcium-47 is now available, though in limited amounts, at acceptable prices from both U.K. and U.S., and IAEA can concentrate on furthering its applications in clinical work.

Calcium-47 is chemically identical with the non-radioactive calcium isotope, the main bone-building element, and has great metabolic similarity with radioactive strontium-90, but lacks most of the latter's undesirable qualities; for example unlike strontium-90 which emits beta-particles only, calcium-47 emits gamma radiation so that its location in the body can be detected by external counting. Furthermore, it retains its radioactivity for a very much shorter period of time than strontium-90 (half-life 4.7 days against 19.5 years for strontium-90). It can, therefore, be introduced into the human body without undue risk as a means to study the still very little known calcium metabolism of the human bone. This might yield important results for the detection of bone disease and the early location of tumors and for the development of methods for the prevention of radiation damage.—(IAEA News.)

### Memory Molecules

It has recently been suggested that memory may consist of information coded in giant molecules of ribonucleic acid (RNA), which are preserved by replication within the cells of the nervous system. A test lending support to this hypothesis has been reported by W. C. Corning and Erwin R. John of the Centre for Brain Research at the University of Rochester.

The two investigators based their experiment on the fact that planarians, or flatworms, can be conditioned to make a simple response to a stimulus, and that when a flatworm is cut in two, the head end grows a new tail and the tail end a new head. Moreover, when a conditioned planarian is cut in two, the conditioned response is "remembered" by both of the regenerated organisms. Evidently some memory of the response is transmitted to the tail of the planarian before it is cut in two, and this memory is then transmitted back to the new head as it regenerates.

To see if the transmitting substance could be RNA, Corning and John conditioned planarians to avoid a light and divided them into two groups. Planarians in one group were cut in

half and allowed to regenerate normally in pond water. Those in the second group were cut in half and placed in pond water containing a small amount of the enzyme ribonuclease. Since this enzyme breaks down RNA, it should presumably interfere with the passage of intact RNA to the regenerating portion of the severed organism. In a careful series of tests Corning and John found that the conditioned response was indeed "forgotten" by the tails that regenerated new heads in the presence of ribonuclease. However, heads that regenerated new tails in the presence of ribonuclease retained their conditioning. In other words, the memory trace preserved in the head section was unaffected by ribonuclease, but that in the tail section could no longer be transmitted back to a new head, where it is evidently needed if the planarian is to recall its conditioning. Although the tests do not prove that the conditioning is stored in RNA, they are consistent with that hypothesis.—(Scientific American, December 1961, 205, 76.)

### Natural Glass from Beneath the Atlantic Floor

During April-May 1961 on a cruise of the R. V. *Chain*, a programme of coring deep-sea sediments from the Atlantic for geochemical investigations was conducted. At 19° 23' N, 40° 53' W. a corer was lowered through 4,430 m. of water to the summit of a rise on the ocean floor. At the point where the corer struck the sea bed surface sediment is a red clay, but no sediment core was obtained since at a very short distance below the surface the red clay is underlain by solid material. The corer struck and broke the surface of this solid material, a fragment of which was recovered in the pilot corer, together with the overlying red clay. From the position of the solid fragment in the pilot corer the thickness of the clay can be estimated to be not more than 38 cm. The solid fragment is a very dark-brown, almost black natural glass of irregular shape, but with approximate dimensions  $3 \times 2.5 \times 1.3$  cm. Red clay containing broken shards of the same glass was found adhering to the piston of the main corer. It is believed to represent the solid surface on which the overlying sediments rest. So far as is known this is the first sample collected of solid rock indisputably from below the sediments of the deep Atlantic.—(Nature, 1961, 192, 156.)

### New Particle : Omega Meson

A new elementary particle, the existence of which had been predicted, has been discovered at the Lawrence Radiation Laboratory of the University of California. Called the omega-meson, the new particle has a mean life of about

10<sup>-22</sup> second, a mass 1,540 times that of the electron, and no electric charge.

Theoretical physicists had conjectured that the omega-meson and a companion particle, the rho-meson, were needed to explain certain characteristics of the neutron and proton first reported two years ago by Hofstadter *et al.* The results of their scattering experiments with high energy electrons and atomic nuclei showed that in the process, in addition to the familiar pions, two heavier types of meson, namely the rho and the omega, should be produced. It was conjectured that the rho-meson could be positive, negative or neutral; the omega-meson only neutral.

The two new mesons would be so short-lived that they could not be detected by a bubble chamber. Theory suggested that the rho-meson would decay into two pions (+ and -) and the omega-meson into three pions (+, - and 0). The search for the rho- and omega-mesons consisted of making "kinematic" analyses of many pion-producing systems. By this method the rho-meson was discovered independently by a number of laboratories last year. The Lawrence Radiation Laboratory Scientists finally found the omega by studying the pion tracks produced when antiprotons produced by their Bevatron were annihilated in collision with protons inside a 72-inch hydrogen bubble chamber.

#### Jubilee Numbers and Commemoration Volumes

*Journal of the Indian Mathematical Society.*—The Indian Mathematical Society was founded in 1907. To mark the occasion of the Golden Jubilee (50 years); the Society has brought out a Golden Jubilee Volume which appears in two parts: Part I, pages 1-341 and Part II, pages 343-677. They have been issued as the *Journal of the Indian Mathematical Society*, Vol. XXIV, Nos. 1 and 2, March-June 1960, and Nos. 3 and 4, September-December 1960. They contain invited articles, 17 in Part I and 18 in Part II, from distinguished mathematicians from India and abroad. The papers represent a cross-section of the various branches of mathematics in which researches are being carried on.

*Proceedings of the National Institute of Sciences.*—The National Institute of Sciences of India, New Delhi, has brought out special supplements of its Journal to celebrate the

Silver Jubilee (25 years) of its establishment. There are two supplements in Part A—*Physical Sciences* and one in Part B—*Biological Sciences*.

Vol. 26, Part A—Supplement I (1960, pp. 289. Price Rs. 20.62) contains 21 papers on Geology, Chemistry and Biochemistry. Vol. 26, Part A—Supplement II (1960, pp. 209. Price Rs. 11.87) contains 18 papers mostly on Pure and Applied Mathematics, and Statics and Theoretical Physics. Vol. 26, Part B, Supplement (1960, pp. 351. Price Rs. 25) contains 25 papers covering various topics in Biological Sciences.

All the contributions are from the Fellows of the Institute and their co-workers. They embody the results of recent original researches or are in the nature of review articles on the topics concerned.

*Mahadevan Volume.*—In commemoration of the 61st Birthday of Prof. C. Mahadevan, Indian Geologist, the Publication Committee under the Editorship of Dr. M. S. Krishnan has brought out a collection of Geological papers. The volume of about 250 pages contains 26 articles contributed by 30 geologists including six from outside India. The articles cover various branches of geology. *The Mahadevan Volume* will be a useful addition to the current literature on Geology and will be welcomed especially by young geologists who will find in it the results of recent researches on various problems.

*The Mahadevan Volume* can be had from Dr. S. Balakrishna, Geology Department, Osmania University, Hyderabad-7 (India). (Price Rs. 6.50); \$ 2.00 or 12 sh. 6d. nett.)

*Agharkar Commemoration Volume.*—To celebrate the 75th Birthday of Prof. S. P. Agharkar, the well-known Indian Botanist, on December 11, 1958, many of his friends and pupils joined to bring out a *Souvenir Volume*. Prof. Agharkar had been in failing health since August 1956, and died on September 2, 1960.

What the Committee had planned to be a commemorative volume has now in effect become a Memorial Volume. The volume of 144 pages contains 15 articles of botanical interest and includes a biographical sketch of the late Prof. Agharkar by T. S. Mahabale and G. T. Tonapi. The volume has been edited by Dr. T. S. Mahabale, University of Poona, Poona-7.

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the classification of structure problems. Now, however, the emphasis has been shifted to the measurement of intensities of Raman lines. Modern methods of measurement of intensity employing photoelectric principles and use of photomultiplier tubes have made intensity study convenient, accurate and reliable. This aspect of the problem is bound to play an increasing role in the future.

A section of some importance in this part of the book concerns polarizability and the theories associated with it. There is no satisfactory theory which enables relative intensities of Raman lines to be predicted. The matrix techniques for vibrational problems are generally extended to obtain intensity relations in terms of polarizability functions which are characteristic of the bonds defining the normal modes of vibrations. The general theory is simplified by making approximations first suggested by Wolkenstein. In this approximation each distinct bond is characterized by three polarizability functions. These may be deduced from measured intensities much in the same way as force constants may be deduced from frequencies.

Another section of interest is the one on Resonance Raman Effect. This concerns the enormous increase in intensity shown by certain Raman lines when the exciting wavelength is chosen in the vicinity of an absorption band characteristic of the substance. In developing the theory of polarization of the Raman effect it is assumed that the exciting line chosen for the study is far away from any of the absorption bands characteristic of the substance under investigation. As the most commonly used source is the mercury arc whose lines in the visible region are used as the exciting lines, the above assumption necessarily limits the study to colourless substances only. If one desires to study substances with marked absorptions in the blue or the green region, one generally chooses the exciting line from that region of the spectrum where no absorption band exists. However, Schorygin, and also Harmand, have proved that there is no basis for such a restriction in the choice of the exciting wavelength. In fact they have found experimentally that under certain conditions, the intensities of specific Raman lines rise enormously when the exciting line is taken close to an absorption band. This effect is known as the Resonance Raman effect. From theoretical considerations it is shown that when the exciting line  $\nu_0$  is very near an absorption band,  $\nu_{\text{abs.}}$  of the substance the intensity of the Raman line is not only proportional to  $\nu_0^4$

but also to  $(\nu_0^2 - \nu_{\text{abs.}}^2)^{-4}$ . An example of the Resonance Raman effect with the spectacular increase in intensity of a millionfold, on a corrected intensity scale, is given in article 124 of the book for the intensity of the  $1,600 \text{ cm.}^{-1}$  frequency of  $\text{C}=\text{C}$  bond in polyenes. The section on Resonance Raman effect gives the semiclassical theory of Schorygin as also the more accurate wave mechanical theory of Behringer. It may be pointed out that Placzek's theory also shows that in the case when the exciting frequency becomes very near a resonance frequency, the intensities of Raman lines, especially of harmonics and combinations of fundamental vibrations, are considerably increased.

In the second part on experimental techniques and investigation methods, the authors have attempted to give an extensive and complete account of all problems connected with the different types of apparatus used in modern time for the study of Ramanspectra. The treatment is so clear that it should be possible for any one interested in any special work in Ramanspectra to build the necessary Raman apparatus and to evaluate its performance. Particular mention should be made about the treatment of intensity measurements. The peak and integrated intensities of a line are defined. The effects of various parameters on measured intensities are discussed, such as volume of specimen, refractive index, temperature, absorption, polarization, spectral sensitivity of the detector, recording speed, etc. The relation between the two intensities is discussed in terms of the profiles of Raman and exciting lines, and the performance of the monochromator. Applications to quantitative analysis and the structural problems are considered, together with the determination of polarizabilities and intermolecular forces.

Of the various types of instruments described in this part special mention should be made of the Steinheil-spectrograph with the photoelectric registering equipment for measurement of peak and integrated intensities; and to the "Cary" Ramanspectrometer which with its double grating monochromator of  $100 \text{ cm.}$  focal length,  $10 (\text{cm.})^2$  aperture, and  $20 \text{ cm.}$  high (!) double slit, is perhaps the largest and best of all the industrial equipment at present known for Ramanspectroscopy, particularly with respect to light-gathering power.

In the third part of the book which perhaps is the most important portion from the point of view of information and data the authors have presented carefully selected results of applica-

tions of Raman spectroscopy under the following heads: Frequencies and Intensities of Raman lines, Determination of Molecular parameters, Interaction between molecules, Resonance Raman effect, Analysis of Organic Compounds and mixtures, and Application and results in inorganic chemistry. Although the selection may appear to be a small part of the vast material actually available, there is no doubt that it truly represents a cross-section of the different regions of applications of Raman spectroscopy.

The book contains 193 diagrams and 72 tables in the text. There is also an appendix containing many useful and reference tables. Sir C. V.

Raman has contributed a Foreword to the book and his photograph appears as the frontispiece.

The book will be an indispensable acquisition to workers on Raman spectra. It is the first book of its kind in recent years to give a compressed but clear account of the "international investigations" of the last thirty years in a subject whose new applications are widening rapidly. As Sir C. V. Raman has pointed out in his Foreword there is "no doubt that the authors' efforts will be rewarded by a cordial reception of the book by numerous workers in different branches of pure and applied science".

A. S. GANESAN.

## MASER ACTION AS ORIGIN OF RADIO EMISSION FROM COSMIC GAS CLOUDS

**T**HEORIES about the mechanism of emission of radio waves from cosmic gas clouds are still of a speculative nature. The usual explanation is based on the observed finding that all the strong radio sources contain tenuous gaseous masses with rapid internal motions (e.g., Crab Nebula where random motions of several hundred kilometres per second are found). When such motions exist acceleration of free electrons takes place and, with magnetic fields playing a vital part, radio waves of varying wavelengths and intensities are emitted. Mechanisms depending on magnetic fields or coherent plasma oscillations require conditions that are too idealized or exceptional, and in any case they do not afford a satisfactory explanation of the phenomenon.

A plausible mechanism for generating radio waves from cosmic clouds is by means of "free-free" transitions of electrons. When an electron has positive energy in the field of a positive ion, it is said to be "free". Classically a free electron describes a hyperbolic orbit about the ion, which is specified by the parameters  $v$  and  $p$ , the velocity of the electron at infinity and the perpendicular distance between the positive ion and the asymptote to the orbit. Quantum mechanically, the electron occupies one of a continuum eigen-states specified by a set of quantum numbers which are the same as for the discrete bound states except that the principal quantum number  $n$  is now continuously variable and the angular momentum quantum number no longer has the upper limit  $(n-1)$ .

Hitherto the objection to the "free-free" emission mechanism has been that the intensity

of radiation received from radio sources greatly exceeds that to be expected if the sources radiate as a blackbody (except in the case of the so-called "thermal sources" such as H II regions). In a paper contributed to the *Astrophysical Journal* (1961, 134, 963), P. F. Browne proves that the emission from both the non-thermal and thermal sources can be explained as due to free-free transitions, but that in the former case the intensity is amplified by a negative absorption coefficient, as in the solid state maser amplifier; that is, because of the physical conditions in the non-thermal sources, stimulated emissions outweigh absorptions. There is nothing unexpected about this mechanism. In any physical system in which there is absorption, there must also be stimulated emission, and there is always the possibility that the latter will outweigh the former. According to Browne "the onus is therefore to prove that the maser principle cannot operate for free-free transitions rather than to show that it can."

Adopting a quantum mechanical approach and using the matrix elements evaluated by Gaunt, Browne shows from theoretical considerations that the delicate balance between absorption and stimulated emission for free-free transitions in a gas plasma can lead to a negative as well as a positive effective absorption coefficient. This means that amplification by stimulated emission may be the possible mode of origin for cosmic radio waves. Further it may be noted that Erikson has pointed out that free-free emission will be polarized if the motion of electrons relative to protons are orderly (e.g., Crab Nebula).

# STUDIES ON THE PROTEINS, PEPTIDES AND FREE AMINO-ACID CONTENTS IN SOME SPECIES OF *PADINA* FROM SOUTH-EASTERN COAST OF INDIA

DR. E. J. LEWIS  
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IN continuation of previous work,<sup>4</sup> the amino-acid constituents of the proteins, peptides and free state were studied in the three species of *Padina*: *P. distromatica* Hauck., *P. gymnospora* (Kuetz.) Vickers and *P. tetrastromatica* Hauck., to ascertain whether any variation occur in them. Algae were collected from the south-eastern coast of India in the months of February and March. These were preserved and analysed as described previously.<sup>4</sup>

The results are given in Tables I, II and III. The results of the protein hydrolysates are expressed as amount in grams per 16 g. of protein N, while those of the peptide hydrolysates and the free amino-acids, as micrograms per gram dry weight of the alga. The amino-acids which were not estimated quantitatively because of diffusion of the bands or interference of other compounds or minuteness of their quantities, are denoted by the "+", "++", etc., signs. An increasing number of these signs indicate relatively larger concentration of those amino-acids with the colour reagent used, the depth of colour being judged merely by visual colour comparison. Moreover, although hydroxyproline and tryptophan (specially in the protein hydrolysates) occurred in estimable amounts due to inadequacy of equipment these were not estimated *in toto*, and are indicated by the "+" signs. Leucine and isoleucine were estimated together and are referred to as "leucine(s)".

Of the twenty-two amino-acids detected in the protein hydrolysates (cf. the comments on the occurrence of  $\gamma$ -amino-butyric acid, homocystine and ornithine in the protein hydrolysates<sup>4</sup>) except homocystine, all were consistently found. Among these except hydroxyproline and tryptophan, all were consistently estimated. Although the qualitative composition of the amino-acids was similar in these species, significant variation in the amounts was observed in these constituents except aspartic acid, glutamic acid, histidine, homocystine (when estimated), leucine(s), lysine, tyrosine and valine; but the magnitude of these variations was varied for the individual amino-acids. Despite these changes, usually proline, aspartic acid, glutamic acid, leucine(s), phenylalanine, histidine and glycine occurred in large amounts while the others, in fairly

large quantities except  $\gamma$ -amino-butyric acid, homocystine, lysine and ornithine which were usually in poor concentrations.

Both qualitative and quantitative variations occurred in the peptide hydrolysates of these algae. Of the nineteen amino-acids recorded only  $\alpha$ -alanine, leucine(s), phenylalanine, proline, tyrosine and valine occurred consistently. All these were consistently estimated except phenylalanine and tyrosine. Although all the amino-acids were in poor amounts, comparatively, proline was consistently in large amount and in certain species (e.g., *P. gymnospora*) this had contributed a major portion of the peptides.

TABLE I

Comparative account of the protein hydrolysates  
in some species of *Padina* from south-eastern  
coast of India

(Calculated as amount in grams per 16 g. of protein N)

Compound	<i>Padina distromatica</i>	<i>Padina gymnospora</i>	<i>Padina tetrastromatica</i>
$\alpha$ -Alanine	.. 4.89	4.66	3.89
$\gamma$ -Aminobutyric acid	.. 0.92	0.78	0.57
Arginine	.. 2.29	3.73	7.55
Aspartic acid	.. 6.57	7.61	7.32
Cystine	.. 4.13	3.73	2.63
Glutamic acid	.. 7.19	6.99	6.75
Glycine	.. 6.12	5.44	4.69
Histidine	.. 6.42	6.06	5.72
Homocystine	.. ..	0.93	0.92
Hydroxyproline	.. +++	+++	+
Leucine (s)	.. 6.12	6.68	6.06
Lysine	.. 1.68	1.55	1.49
Methionine	.. 2.91	3.11	2.29
Ornithine	.. 0.92	1.24	1.14
Phenylalanine	.. 7.19	5.59	5.03
Proline	.. 7.34	9.48	5.95
Serine	.. 4.43	4.66	3.66
Threonine	.. 5.05	4.97	3.66
Tryptophan	.. ++	++	+
Tyrosine	.. 3.82	2.95	2.97
Valine	.. 3.06	2.64	2.63
Number detected	.. 21	22	22
Number estimated	.. 19	20	20
Amount in grams per 16 g. of protein N	81.05	77.80	74.90
Amount in grams per 100 g. of the dry alga	5.30	5.33	6.55
Protein N in grams per 100 g. of the dry alga	1.05	1.03	1.40
Per cent. recovery of protein N	69.73	72.91	71.18

TABLE II

Comparative account of peptide hydrolysates in some species of *Padina* from south-eastern coast of India

(Calculated as micrograms per gram dry weight of the alga)

Compound	<i>Padina disto-</i> <i>matica</i>	<i>Padina gymno-</i> <i>spora</i>	<i>Padina tetra-</i> <i>stromatica</i>
$\alpha$ -Alanine	.. 2.13	0.39	1.57
$\beta$ -Alanine	.. 1.15	..	..
$\gamma$ -Aminobutyric acid	.. ..	+	0.84
Arginine	.. ..	..	0.94
Aspartic acid	.. 0.71	..	1.35
Cystic acid	.. ++	..	..
Cystine	.. 0.73	..	0.91
Glutamic acid	.. 0.78	..	1.20
Glycine	.. 2.16	..	..
Histidine	.. ++	..	++
Leucine (s)	.. 3.08	0.61	4.38
Lysine	.. ..	0.68	1.72
Ornithine	.. 1.65	..	..
Phenylalanine	.. 3.55	++	5.33
Proline	.. 6.63	12.91	3.06
Serine	.. 1.18	..	1.23
Tyrosine	.. 1.73	++	++
Valine	.. 2.04	0.72	5.33
Number detected	.. 16	9	15
Number estimated	.. 14	6	13
Amount estimated	.. 27.52	15.31	25.86

TABLE III

Comparative account of free amino-acids in some species of *Padina* from south-eastern coast of India

(Calculated as micrograms per gram dry weight of the alga)

Compound	<i>Padina disto-</i> <i>matica</i>	<i>Padina gymno-</i> <i>spora</i>	<i>Padina tetra-</i> <i>stromatica</i>
$\alpha$ -Alanine	.. 0.93	1.20	0.50
$\beta$ -Alanine	.. ..	..	++
Arginine	.. ..	++	++
Asparagine	.. ++	..	++
Aspartic acid	.. 1.40	0.35	1.20
Glutamic acid	.. 2.29	1.78	2.26
Glycine	.. +	..	++
Hydroxyproline	.. ++	..	..
Leucine (s)	.. 0.42	++	..
Proline	.. 3.83	5.61	+++
Serine	.. +	..	++
Threonine	.. ++	..	++
Tryptophan	.. +++	+++	++
Tyrosine	.. +	++	++
Valine	.. 0.45	0.45	0.55
Number detected	.. 13	10	13
Number estimated	.. 7	6	4
Amount estimated	.. 9.32	9.39	4.51

All the amino-acids recorded in the protein hydrolysates were found either consistently or occasionally in the peptides except homocysteine, hydroxyproline, methionine, threonine and tryptophan (since all the samples were analysed after acid hydrolysis, tryptophan in the samples might have been destroyed<sup>4</sup>). In addition,  $\beta$ -alanine and cystic acid occurred in the peptide hydrolysates.

Free amino-acids also varied both in quality and quantity in these species. Of the sixteen amino-acids detected,  $\alpha$ -alanine, aspartic acid, glutamic acid, proline, tryptophan, tyrosine and valine occurred consistently. Of these  $\alpha$ -alanine, aspartic acid, glutamic acid and valine occurred consistently in estimable amounts: but none of these was in large quantity.

All the protein hydrolysates occurred consistently or occasionally in the free state except  $\gamma$ -aminobutyric acid, cystine, histidine, homocystine, lysine. In addition  $\beta$ -alanine and asparagine occurred occasionally.

As regards the total amount, the proteins were consistently most, while the free amino-acids, the least. Of the twenty-five amino-acids detected in the proteins, peptides and free state, in these algae,  $\alpha$ -alanine, proline, tyrosine and valine occurred consistently, while  $\alpha$ -alanine and valine were consistently estimated.

Dokhan<sup>1</sup> detected free and combined arginine in *Padina pavona*. Pillai<sup>2</sup> studied *P. australis* and estimated phenylalanine, leucine(s), tyrosine, valine, alanine, glycine, aspartic acid, glutamic acid, serine, threonine, arginine and histidine in the acid hydrolysates of both the mature and the young specimens. Lewis and Gonzalves<sup>3</sup> analysed the protein hydrolysates of *P. tetrastrum* and estimated all the above-mentioned amino-acids<sup>1,5</sup> except arginine, which was detected only. In addition, lysine, methionine and proline were estimated: ornithine and tryptophan were detected.

All the amino-acids recorded by the above workers<sup>1,3,5</sup> are estimated here in the protein hydrolysates except tryptophan, which is detected only. In addition,  $\gamma$ -aminobutyric acid, cystine and homocystine are estimated, while hydroxyproline is detected.

Lewis and Gonzalves<sup>2</sup> studied the free amino-acid contents of *P. tetrastrum* and estimated  $\alpha$ -alanine, aspartic acid, glycine and valine; in addition, cystine, glutamic acid, leucine(s), ornithine, proline, serine, threonine and tryptophan were detected.

All the amino-acids mentioned above<sup>2</sup> are either estimated or detected here in the free state except cystine and ornithine. In addition,

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Leucine (s)	.. 3.08	0.61	4.38
Lysine	.. ..	0.68	1.72
Ornithine	.. 1.65	..	..
Phenylalanine	.. 3.55	++	5.33
Proline	.. 6.63	12.91	3.06
Serine	.. 1.18	..	1.23
Tyrosine	.. 1.73	++	++
Valine	.. 2.04	0.72	3.33
Number detected	.. 16	9	15
Number estimated	.. 14	6	13
Amount estimated	.. 27.52	15.31	25.86

TABLE III

Comparative account of free amino-acids in  
some species of *Padina* from south-eastern coast  
of India

(Calculated as micrograms per gram dry weight of the alga)

Compound	<i>Padina distro- matica</i>	<i>Padina sym- phora</i>	<i>Padina tetra- stromatica</i>
$\alpha$ -Alanine	.. 0.93	1.20	0.50
$\beta$ -Alanine	.. ..	..	++
Arginine	.. ..	++	++
Asparagine	.. ++	..	++
Aspartic acid	.. 1.40	0.35	1.20
Glutamic acid	.. 2.29	1.78	2.26
Glycine	.. +	..	++
Hydroxyproline	.. ++	..	..
Leucine (s)	.. 0.42	++	..
Proline	.. 3.83	5.61	+++
Serine	.. +	..	++
Threonine	.. ..	..	++
Tryptophan	.. +++	+++	++
Tyrosine	.. +	++	++
Valine	.. 0.45	0.45	0.55
Number detected	.. 13	10	13
Number estimated	.. 7	6	4
Amount estimated	.. 9.32	9.39	4.51

All the amino-acids recorded in the protein hydrolysates were found either consistently or occasionally in the peptides except homocystine, hydroxyproline, methionine, threonine and tryptophan (since all the samples were analysed after acid hydrolysis, tryptophan in the samples might have been destroyed<sup>1</sup>). In addition,  $\beta$ -alanine and cysteine acid occurred in the peptide hydrolysates.

Free amino-acids also varied both in quality and quantity in these species. Of the sixteen amino-acids detected,  $\alpha$ -alanine, aspartic acid, glutamic acid, proline, tryptophan, tyrosine and valine occurred consistently. Of these  $\alpha$ -alanine, aspartic acid, glutamic acid and valine occurred consistently in estimable amounts; but none of these was in large quantity.

All the protein hydrolysates occurred consistently or occasionally in the free state except  $\gamma$ -aminobutyric acid, cystine, histidine, homocystine, lysine. In addition  $\beta$ -alanine and asparagine occurred occasionally.

As regards the total amount, the proteins were consistently most, while the free amino-acids, the least. Of the twenty-five amino-acids detected in the proteins, peptides and free state, in these algae,  $\alpha$ -alanine, proline, tyrosine and valine occurred consistently, while  $\alpha$ -alanine and valine were consistently estimated.

Dokhan<sup>1</sup> detected free and combined arginine in *Padina pavona*. Pillai<sup>5</sup> studied *P. australis* and estimated phenylalanine, leucine(s), tyrosine, valine, alanine, glycine, aspartic acid, glutamic acid, serine, threonine, arginine and histidine in the acid hydrolysates of both the mature and the young specimens. Lewis and Gonzalves<sup>3</sup> analysed the protein hydrolysates of *P. tetrastrumatica* and estimated all the above-mentioned amino-acids<sup>1,5</sup> except arginine, which was detected only. In addition, lysine, methionine and proline were estimated; ornithine and tryptophan were detected.

All the amino-acids recorded by the above workers<sup>1,3,5</sup> are estimated here in the protein hydrolysates except tryptophan, which is detected only. In addition,  $\gamma$ -aminobutyric acid, cystine and homocystine are estimated, while hydroxyproline is detected.

Lewis and Gonzalves<sup>2</sup> studied the free amino-acid contents of *P. tetrastrumatica* and estimated  $\alpha$ -alanine, aspartic acid, glycine and valine; in addition, cystine, glutamic acid, leucine(s), ornithine, proline, serine, threonine and tryptophan were detected.

All the amino-acids mentioned above<sup>2</sup> are either estimated or detected here in the free state except cystine and ornithine. In addition,



$\beta$ -alanine, arginine, hydroxyproline and tyrosine are detected.

The algæ studied here are comparatively poorer in the proteins and free amino-acids than those reported earlier.<sup>2,3</sup> This might have been due to the variations in the habitat of the specimens studied. However, the record of some additional ones made here, is most likely due to the improved methods of analysis employed in the present investigation. Since the identical species, viz., *P. tetrastromatica* investigated earlier<sup>2,3</sup> as well as in this investigation, differed in amount of proteins and free amino-acids, it seems a study of these variations in the different species of the same genus, as well as under varied ecological conditions, is necessary in order to evaluate the importance of the data

in the taxonomical and nutritional studies of any algal specimen.

The author wishes to acknowledge his indebtedness to Prof. (Mrs.) Ella A. Gonzalves, Institute of Science, for the encouragement given during the course of this investigation, and to Dr. (Mrs.) Francesca Thivy, Algologist at the Central Salt Research Institute, Bhavnagar, for confirming the identification of the algal specimens.

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## SYMPOSIUM ON FERRO-ALLOY INDUSTRY

**M**ETALLURGICAL partnership of special and alloy steels with the ferro-alloys started more than a century ago when Robert Mushet happened to add manganese to the then newly invented Bessemer-Kelly process of pneumatic steel-making, providing thereby the solution to a major cri-de-cœur in the metallurgy of steel. Since the turn of the last century considerable developments have taken place in the research and production technology of ferro-alloys which have led to the phenomenal growth of ferro-alloy industry in different parts of the world. These developments in ferro-alloy's production technology have, however, been exceedingly slow in their impact in India.

In order to focus attention on the latest technological trends and research developments in the production of ferro-alloys, a symposium on 'Ferro-Alloy Industry in India' was organised by the National Metallurgical Laboratory from February 12 to 15, 1962, to exchange technical know-how with the leading scientists, and metallurgists from different parts of the world in the context of the interrelated problems facing the industry and its growth along scientific and economic lines. The Symposium drew a large gathering of top-ranking scientists and technologists from all over the world besides a large number of distinguished delegates from India.

The Symposium was inaugurated by Prof. M. S. Thacker, Director-General, Scientific

and Industrial Research; Sir Jehangir Ghandy, Chairman of the Executive Council, National Metallurgical Laboratory, presided, and Dr. B. R. Nijhawan, Director, National Metallurgical Laboratory, welcomed the distinguished delegates.

Twenty-nine technical papers covering the various aspects of research and development work on ferro-alloys and their production and properties were presented and discussed in six technical sessions. The subjects covered relate to (i) survey of raw materials, sampling methods and role of research; (ii) extraction and production technology; (iii) scope for development of ferro-alloy industry, utilisation of by-products and methods of standardisation; (iv) physico-chemical principles involved in the ferro-alloy production; and (v) general aspects of ferro-alloy technology.

The *National Metallurgical Laboratory Technical Journal* for February 1962 (Vol. IV, No. 1) is a Symposium Number and contains besides the abstracts of all the papers presented at the Symposium, the following technical papers in greater detail: "Some Aspects of the Sampling and Analysis of Ferro-Alloys" by G. M. Holmes; "The Extraction of Vanadium from Titanium Iron Ores" by A. G. Robiette; "Some Applications of Rapid Metallurgy to the Manufacture of Ferro-Alloys" by R. Perrin and A. Greffe; "Electrolytic Manganese in a Non-Diaphragm Cell" by G. Bjorling and N. G. Elfstrom.

## SYMPOSIUM ON PLANT TISSUE AND ORGAN CULTURE

FROM December 22 to 29, 1961, the Department of Botany, University of Delhi, Delhi, was the venue of an international symposium on "Plant Tissue and Organ Culture", organized jointly by the UNESCO South Asia Science Co-operation Office, New Delhi, and the University of Delhi. Forty-one delegates from eight nations took part. Chief among them were Professor F. C. Steward (Ithaca, U.S.A.), Professor H. E. Street (Swansea, U.K.), Professor J. Reinert (Berlin-Dahlem, West Germany) and Dr. J. P. Nitsch (Gif-sur-Yvette, France). Of the rest the majority were from universities and research institutions in India, although Burma, Ceylon and Malaya were also represented.

Professor P. Maheshwari, President of the Symposium, welcomed the participants, and Dr. J. Swarbrick, Director, UNESCO South Asia Science Co-operation Office, made brief remarks about the scope and aims of the Symposium. While inaugurating the Symposium, Professor Humayun Kabir, Minister for Scientific Research and Cultural Affairs, Government of India, New Delhi, spoke of the role of such meetings in fostering scientific advancement and goodwill among the participating countries. In his address, Professor Maheshwari highlighted the history of tissue and organ culture and spoke of its increasing utility in tissue therapy, virology, pharmacognosy, plant pathology, agriculture and horticulture. Dr. B. M. Johri proposed the vote of thanks.

In all there were nine sessions. In eight of them 35 papers were presented. The experimental objects ranged from mosses to flowering plants, and from roots to fruits. In the session on root culture, there were discussions on the use of radioactive sugars to test the superiority of sucrose over any other sugar (Thomas, Craigie and Street, *Swansea*), the use of amino-acids as sources of nitrogen in root cultures (David, *Poona*), the pathways of DPN synthesis in excised roots and shoots of corn (Hanson, Morton and Ramakrishnan, *Baroda*) and the culture of root tips, haustoria and lateral buds of sandal (Srimathi and Sreenivasaya, *Bangalore*).

The potentialities of free cells (Steward, *Ithaca*), the interaction of kinetin and auxins on the callus of horse-radish (Sastri, *Waltair*), the nutrition of free cells of poppy (Ranganathan, Mascarenhas, Sayagaver and Jaganathan, *Poona*) and organogenesis in the callus

cultures of an orchid (Rao, *Singapore*) engaged the participants during another sitting.

From the papers on male cones, microsporangia and microspores one could infer that the development of male cones and pollen grains of pine proceed normally in cultures (Konar, *Delhi*), the 1-celled microspores of onion grow only if the medium contains RNA-nucleotides (Vasil, *Delhi*) and chemicals profoundly alter the properties of cytoplasm in pollen tubes (Sen and Verma, *Almora*). Irradiation of culture media with  $Co^{60}$  was suggested as a possible substitute to autoclaving (Rao and Iyer, *New Delhi*).

Cultural studies on inflorescences, flowers and ovaries included observations on correlation of the growth of embryos with the amount of maternal tissue retained on the explants of *Aerva* (Prem Puri, *Delhi*), raising hexaploid plants of *Oryza* (Sapre, *Cuttack*), apogeotropic behaviour of hypocotyl in seedlings of *Allium* (Johri and Spira Guha, *Delhi*) and induction of adventive embryony in *Anethum* (Johri and Sehgal, *Delhi*).

The papers on the culture of nucelli of *Citrus* (Sabharwal, *Delhi*), the behaviour of nucellar seedlings in some Rutaceae (Singh, *Saharanpur*), on culturing ovules of *Gynandropsis* (Chopra and Sabharwal, *Delhi*), and on regeneration in foliar embryos of *Bryophyllum* (Mohan Ram, *Delhi*) also commanded considerable interest. The next session dealt with ferns (Mahabale, *Poona*), a liverwort (Kaul, Mitra and Tripathi, *Lucknow*) and a moss (Lal, *Delhi*). It is worthy of note that the juice of water-melon has some factor which strongly promotes cell division (Lal, *Delhi*).

Based on their requirements for growth in vitro, Nitsch (Gif) categorized callus tissues into three kinds and discussed their potentialities. *Dendrophthæ* (Johri and Bajaj, *Delhi*) and *Orobanche* (Ranga Swamy, *Delhi*) were two other parasites which offered much interesting information. A paper on tissue fragments of mustard (Sen and Verma, *Almora*) and another on the culture of embryos of *Gnetum* (Vimla Vasil, *Delhi*) came next.

The last session included investigations on crown-gall tumours (Gadgil, Roy and Das, *Calcutta*), histogenesis of grass embryos in culture (Narayanaswami, *Trombay*) and effect of colchicine on the embryos of *Chlorophytum* (Thomas, *Trivandrum*).

There were six special lectures: "Carrots and Coconuts — Some Investigations on Growth"

by Professor Steward, "Nutritional Problems Raised by Work with Root Cultures" and "Studies on the Hormonal Control of Root Growth" both by Professor Street "In vitro Culture of Flowers and Fruits" by Dr. Nitsch; "Experimental Modification of Growth and Differentiation in Plant Tissue Culture" by Professor Reinert, and "Plant Tissue and Organ Culture from the Point of View of an Embryologist" by Professor Maheshwari. Suffice

it to say that each of them was rich in illustrative information. In the concluding session there was a brief but objective discussion on "Techniques, Appraisal of Progress and Future Outlook on Tissue Culture Research".

A special feature of the Symposium was the exhibition of live-tissue cultures set up by the Department of Botany.

N. S. RANGA SWAMY.

## A NEW GALVANOMAGNETIC EFFECT IN SEMICONDUCTORS

DR. Sikorski, of the Institute of Fundamental Technical Problems, Polish Academy of Sciences, Warsaw, has carried out a theoretical analysis of the electrical conditions in an inhomogeneous semiconducting specimen, which has one face uniformly illuminated and has a magnetic field applied perpendicular to the face. A general formula for the current density in such a specimen has been deduced and from this a new galvanomagnetic effect has been predicted. Experimental investigations have been carried out to confirm these theoretical predictions (*Proc. Intern. Conf. Semiconductor Phys., Prague, 1960*).

The effect is best observed in a thin rectangular semiconducting plate ( $xy$ ), with electrodes making ohmic contacts at the ends ( $x$  axis). A conductivity gradient ( $d\sigma/dy$ ) exists in the plate perpendicular to its length (i.e., along the  $y$  axis). The upper face is uniformly illuminated (over a length  $l$ ) and the magnetic field ( $B$ ) is applied perpendicular to this face ( $z$  axis). The theory shows that

under these conditions a voltage is developed between the end electrodes. Dr. Sikorski proposes that this effect be called the bulk photoelectromagnetic effect (Bpem). The Bpem may be considered as a Hall effect in which the movement of non-equilibrium current carriers  $\delta p$  in an internal field (directly related to the conductivity gradient) must be taken into effect. The new effect is, however, related to the photoelectromagnetic effect (*Phys. Rev.*, 1956, 101, 1713) and the bulk photo-voltaic effect (*Czech. J. Phys.*, 1956, 6, 96), already known.

In the case of an  $n$ -type semiconductor the expression for the voltage  $U$  (bulk photoelectromagnetic effect) can be reduced to

$$U = - (kT/e) (\epsilon \mu_p \delta p \theta / \sigma^2) (d\sigma/dy) l$$

where  $e$  is the charge of an electron,  $\mu_p$  is mobility of holes,  $\sigma$  is the mean value of the conductivity and  $\theta$  is the product of the Hall mobility and the magnetic field.—(*Nature*, 1962, 193, 32.)

## MEASURING THE POLARIZATION OF RADIO-WAVES

ACCORDING to Prof. H. C. van de Hulst, Professor of Theoretical Astronomy in the State University of Leyden, radio astronomers working at the Dwingeloo Observatory, Netherlands, have been able to prove conclusively that part of the radio-radiation from the universe is polarized. This has been made possible by using a highly specialized receiver and a radio telescope exceedingly well suited to the purpose, which enabled not only measurement of the weak signals but also their analysis.

The electro-magnetic waves which penetrate the earth's atmosphere from the universe and which can be detected with radio-telescopes consist of vibrations in numerous directions. The measurements taken in November and December last showed that a small portion of the radiation from some areas of the heavens was found to

vibrate in one particular direction. This result was forecast by theoretical calculations designed to explain the origin of the radio-radiation. This theory, however, has to be proved and radio astronomers in various countries have been endeavouring in recent years to produce this proof, so far with negative, or at least highly doubtful, results. According to the theory, part of the radio-radiation is emitted by rapidly moving electrons under the influence of magnetic forces. These electrons, which move at speeds almost equal to that of light, describe enormous spiral courses through the Milky Way.

The measurements of polarization at present being carried out provide the theoreticians with an opportunity to pursue their calculations with greater confidence.

## LETTERS TO THE EDITOR

### TRITERPENOIDS I: $\alpha$ -AMYRIN FROM *WRIGHTIA*

THERE are only two species of *Wrightia* (Family—Apocynaceae) available in India, namely *W. tomentosa* Roem. and Schult. and *W. tinctoria* R. Br., on which no thorough chemical studies have so far been made. The present work deals with the triterpene contents of the barks of both.

Air-dried powdered bark (1 kg.) of *W. tomentosa* was exhaustively extracted with rectified spirit by cold percolation. The alcohol-free extract on shaking with petroleum ether (60–80°) gave a semisolid mass. This on chromatography over Brockmann alumina gave principally a white crystalline substance m.p. 200–12° (yield 0.2%). It responded to Liebermann-Burchard reagent and produced yellow coloration with tetranitromethane. Repeated crystallisations from methanol raised the m.p. to 225–26°;  $[\alpha]_D^{27} + 76.4^\circ$ . This was found to be  $\alpha$ -amyrin acetate from mixed m.p. determination with an authentic sample. Hydrolysis to  $\alpha$ -amyrin, m.p. 186°, and preparation of  $\alpha$ -amyrin benzoate, m.p. 194°,  $[\alpha]_D^{27} + 95^\circ$  from the latter confirmed the identity.

Air-dried powdered bark of *W. tinctoria* similarly gave  $\alpha$ -amyrin acetate, m.p. 224–26°;  $[\alpha]_D^{27} + 76.8^\circ$  (yield 0.18%).

We take this opportunity to express our thanks to the Chief Botanist, Botanical Survey of India, for extending facilities for carrying out the work. Thanks are also due to Dr. R. K. Arora, Assistant Ecologist, Botanical Survey of India, Calcutta, for collection and identification of the plant material.

Chemical Unit,  
Botanical Survey of India,  
Calcutta, October 25, 1961.

P. C. MAITI.  
R. M. BERI.

### CHEMICAL INVESTIGATION OF *EULOPHIA NUDA* LINDL.

THE plant *Eulophia nuda* Lindl. known in Sanskrit as *Manya* and in Hindi as *Goruma* belongs to the natural order Orchidaceae. It is distributed in the tropical Himalayas from Nepal eastwards to Sikkim, Assam, Kharria hills and Burma. It is also available in the Deccan from Konkan southwards. The tubers of the

plant are useful for tumours, scrofulous affections of the glands of the neck and in diseases of the blood. The plant is also useful as an anthelmintic and in cases of bronchitis. It is also claimed to be useful in tuberculosis.<sup>1</sup> Due to its important medicinal properties, the chemical investigation of the plant was undertaken.

The petroleum ether extract of the tubers on chromatographic separation over alumina yielded in addition to a yellow wax, two colourless, neutral, nitrogen-free substances, of m.p. 75° and 82°. The former (C, 81.9; H, 13.8, OCH<sub>3</sub>—nil) was identified to be *n*-hexacosyl alcohol by the preparation of its acetyl derivative, m.p. 64° (C, 79.0; H, 13.3%) and a mixed melting point determination of the latter with an authentic specimen. The substance (C, 78.4; H, 13.0%) was too small for identification.

The methanolic extract of the plant was divided into two parts. The first portion (about 15 gm.) was made alkaline and on steam-distillation gave a dark-brown oil (100 mg.) with a strong odour of pyridine. It was redistilled at 115–20° at 0.02 mm. It contained nitrogen but did not give the characteristic tests for alkaloids. Due to variable results of analysis no structure could be assigned to it.

The second portion of the methanolic extract gave on chromatographic separation over alumina an appreciable amount of a brownish oil which could not be purified, together with small amounts of a colourless solid, m.p. 211–12° (C, 84.3, H, 11.4;  $[\alpha]_D^{25} = +28$ ) which gave a positive Liebermann-Burchard test. It was identified as lupeol by a mixed melting point with an authentic specimen and by the preparation of its acetyl derivative, m.p. 214–15° (C, 82.1; H, 11.6).

The authors are thankful to Messrs. Zandu Pharmaceutical works for the supply of *Eulophia nuda* and also for financial assistance to one of us (R. J. S.).

Institute of Science,  
Bombay,  
September 28, 1961.

J. R. MERCHANT.  
MISS R. J. SHAH.  
S. N. HIRWE.

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## STUDIES IN TERPENES:

Part X. Action of Alcoholic Phosphoric Acid  
on  $\alpha$ -Terpineol

In Part VII<sup>1</sup> of this series, the transformations of  $\alpha$ -terpineols with several catalysts were reported. The present work is a continuation of the study and deals with the action of alcoholic phosphoric acid on  $\alpha$ -terpineol.

## REACTION A

$\alpha$ -Terpineol (186.7 g.; 1.21 mole) and 50% alcoholic phosphoric acid (237.2 g.; 1.21 mole) were refluxed together at 101–104° for 20 hrs. in Fisher Hi Temperature Bath. From the reaction mixture, ethanol was distilled off by heating on the bath up to 130°, and the residue on steam distillation gave 141 g. of oil with b.p. 172–188°/737 mm.,  $n_D^{20}$  1.4828,  $d_4^{25}$  0.8499 and  $\alpha_D$ : 0.

*Analyses.*—Fractionation—119 gm. of the oil on fractional distillation yielded the following main fractions: (I) 69.3%, b.p. 172–180°/737 mm.,  $n_D^{20}$  1.4802 and  $d_4^{25}$  0.8400 and (II) 19.3%, b.p. 180–188°/737 mm.,  $n_D^{20}$  1.4882 and  $d_4^{25}$  0.8570.

## Characterisation of Products

*Fraction I.*—(a)  $\alpha$ -Terpinene: (i) *Preparation of  $\alpha$ -terpinene Nitrosite—Modified Procedure.*—A solution of the oil (2.5 g.) in glacial acetic acid (2 c.c.) was frozen in ice-salt bath, and to this water (4.5 c.c.) was added first and then a solution of sodium nitrite (2.5 g. in 3 c.c. of water) drop-wise, with shaking. Cooled and added petroleum ether (b.p. 50°, 6 c.c.), and set aside the reaction mixture for 3–4 days in refrigerator. The solids formed were washed with petroleum ether and recrystallised from aqueous ethanol (yield: 500 mg.; m.p. 155° which was undepressed on admixture with authentic sample of  $\alpha$ -terpinene nitrosite.)

(ii) *Maleic Anhydride and Acid Addition Products.*—Utilising essentially the method of Ipatieff and Pines,<sup>2</sup> the oil yielded the maleic anhydride adduct which when recrystallised from aqueous ethanol melted at 64° (Lit. value for  $\alpha$ -terpinene maleic anhydride adduct: 64–65°). The crop of maleic acid addition product on recrystallisation from aqueous acetone gave a melting point of 128° (Lit. value for  $\alpha$ -terpinene maleic acid adduct: 127–128°).

(b) *Dipentene.*—Attempts to recognise this *p*-menthadiene via mercuric acetate complex<sup>3</sup> and tetrabromide<sup>4</sup> were unsuccessful.

(c) *Terpinolene.*—Although the oil responded to acetic anhydride-sulphuric acid test,<sup>5</sup> bromi-

nation<sup>1</sup> did not afford any workable quantity of the derivative.

(d) *1:8-Cineole.*—With hydroferrocyanic acid,<sup>6</sup> the oil furnished only traces of complex corresponding to the oxide.

(e) *p-Cymene.*—This aromatic was recognised and estimated by isolation of the saturates and oxidation to terephthalic acid (7.2%).<sup>7</sup>

*Fraction II.*—Terpinolene was identified by preparation of the tetrabromide on the lines recommended earlier.<sup>1</sup> From the oil (1.7 g.) dissolved in amyl alcohol (2 c.c.) and diethyl ether (4 c.c.), about 150 mg. of the tetrabromide of m.p. 116° was obtained. This m.p. was not depressed on admixture with authentic terpinolene tetrabromide.

## REACTION B

A mixture of  $\alpha$ -terpineol (56 g.; 0.363 mole) and 50% alcoholic phosphoric acid (71.2 g.; 0.363 mole) was magnetically stirred at 25–30° for 20 hrs. Added ice-cold water (50 c.c.) and stirred further for 5 mts. Kept the reaction mixture for 20 hrs. in refrigerator. No crystals of terpin hydrate separated out. The recovered oil from the reaction mixture was purified by steam distillation (yield: 54.3 g.; b.p. 212–214°/737 mm. and  $n_D^{20}$  1.4825).

*Analyses of the Steam Distillate.*—The boiling point and refractive index of the oil indicated that  $\alpha$ -terpineol was essentially unaffected by the catalyst. Hydration to terpin hydrate justified this conclusion:

*Hydration.*—Under ice-cold conditions, the oil (9.4 g.) and 50% sulphuric acid (60.5 g.) were vigorously stirred magnetically for 5 mts. Kept the reaction product for 20 hrs. in refrigerator. Solids got were washed successively with petroleum ether, 20% sodium carbonate solution and water, and dried on porous plate (yield: 5 g.). From the filtrate, after cooling and stirring for 30 mts. and repeating the afore-mentioned steps, a further quantity of solids was obtained (yield: 1 g.). On recrystallisation from hot water, it melted at 118°; this m.p. was undepressed on admixture with authentic terpin hydrate.

$\alpha$ -Terpineol under similar experimental conditions afforded 7.1 g. of terpin hydrate.

## CONCLUSIONS

$\alpha$ -Terpineol, on interaction with alcoholic phosphoric acid gave rise to monoterpenoids which included  $\alpha$ -terpinene, terpinolene, *p*-cymene and small amounts of 1:8-cineole. On the other hand, stirring with the catalyst at room temperature did not cause any dehydra-

on; this was proved by hydrating the oil recovered to terpin hydrate by a brief processing with sulphuric acid.

We are indebted to Hercules Powder Co., Wilmington, U.S.A., for a gift of  $\alpha$ -terpineol.

Dept. of Chemistry, K. K. SUGATHAN.  
Christian Medical College, JAMES VERGHESE.  
ellore (N. Arcot),  
February 1, 1962.

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## HARDBOARDS FROM *QUERCUS* SPECIES

At the request of the Punjab Forest Department work on hardboards from *Quercus* species (said to be *Quercus incana*) was undertaken.

The pulp was prepared by two different processes. In the first process the wood was converted into chips in a Thies chipper and these chips sprayed with 7% caustic soda solution. The chips were then defibrated in a Condux mill. In the second method the chips were cooked in soda or lime solution at atmospheric pressure in a stainless steel vessel and then passed through a Condux mill.

The pulp was washed and felted in a laboratory mould and pressed in the hot press.

The results are given in Table I. As can be seen the strength results are good. Modulus of rupture values over 300 kg./cm.<sup>2</sup> going up to 730 kg./cm.<sup>2</sup> have been obtained. But water absorption values are very high, excepting with boards 4, 5 and 8. With addition

TABLE I  
Physical properties of hardboards prepared from *Quercus* species

No.	Chemicals used and Method of preparation	Pulp	Pressing conditions		Density gm./cm. <sup>3</sup>			Bending strength Kg./sq. cm.			Water absorption 24 hrs. (%)			
		Yield %	Pressure Kg. sq. cm.	Temp. ° C.	Time minutes	Untempered	Oven tempered	Oil tempered	Untempered	Oven tempered	Oil tempered	Untempered	Oven tempered	Oil tempered
		2	3	4		5			6			7		
	Sprayed with 7% soln. of NaOH for 1 hr. (Cold) (1.4 : 1)	55.7	56.25	160 30	0.80	0.99	0.96	127.3	150.4	127.8	112.2	71.2	43.8	
	Sprayed with 7% soln. of NaOH for 2 hrs. (Cold) (1.6 : 1)	62.5	56.25	160 30	1.07	1.07	1.09	281.6	303.3	376.3	106.9	78.5	58.1	
	Boiled with 0.1% soln. of NaOH for 2 hrs. (18.1 : 1)	65.4	56.25	160 30	0.99	1.00	1.03	191.8	217.5	363.8	123.9	59.8	26.4	
	Boiled with 0.5% soln. of NaOH for 1 hr. (16.6 : 1)	58.3	56.25	160 30	1.03	1.03	0.98	270.9	333.2	534.3	90.13	47.8	16.6	
	Boiled with 0.5% soln. of NaOH for 2 hrs. (20 : 1)	61.0	56.25	160 30	0.97	0.94	1.01	193.8	237.0	374.8	69.3	37.6	22.3	
	Boiled with 1.0% soln. of NaOH for 1 hr. (18.1 : 1)	60.0	56.25	160 30	1.13	1.09	1.15	384.8	462.6	730.5	97.2	66.8	48.8	
	Boiled with lime of 0.9% concentration for 2 hrs. (16.6 : 1)	65	56.25	160 30	1.03	0.88	1.08	231.9	260.2	269.3	79.5	62.1	41.9	
	Boiled with lime of 1.8% concentration for 2 hrs. (16.6 : 1)	64.1	56.25	160 30	1.04	1.11	1.14	244.4	296.4	406.5	85.3	39.3	21.8	

of size or suitable choice of tempering conditions it should be possible to effect improvement in this property.

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### METHODS FOR DETERMINATION OF AVAILABLE POTASSIUM IN INDIAN SOILS

FIELD experiments so far conducted in India indicate that the need for potassium is not felt at the present level of crop production in a majority of soils. Even a depression in yield is occasionally reported (Parthasarathy, 1952). In some laterites and other acid soils, however, the application of potassium in combination with optimum doses of N and P have shown responses (Mukherjee, 1952).

At the Indian Agricultural Research Institute studies were conducted with the soils collected from T.C.M. agronomic trials. The soils from Dumka in Bihar and Chalakudi (Kerala) which showed response to potash fertilizers were analysed by the following methods: (1) 1% citric acid, (2) normal ammonium acetate, (3) Morgan's extractant, (4) 0.5 N nitric acid (heating for 1 hour at 95°C.), (5) 0.5 N nitric acid (½ hour's shaking) and (6) % K saturation. The correlation between the available potassium as obtained by different methods and responses of paddy to potassium fertilizers were calculated and are given in Table I.

TABLE I

Coefficients of correlations between available potassium and yields of paddy

Method	Soils from Dumka (Bihar)	Soils from Chalakudi (Kerala)
(a) 1% citric acid (Dyer, 1894) ..	-0.25	-0.65*
(b) 1 N. ammonium acetate (Hanway and Haidal, 1952)	-0.21	-0.4*
(c) Morgan's extractant (Morgan, 1952)	-0.46*	-0.64*
(d) 0.5 N nitric acid (1 hour's heating) (Oommen, 1959)	-0.34	-0.64*
(e) 0.5 N nitric acid (½ hour's shaking) (Oommen, 1959)	-0.23	..
(f) % K saturation (Mukherjee, 1952)	-0.30	-0.81†

\* Significant at 5% level. † Significant at 1% level.

It is seen that in the case of Dumka soils, only the Morgan's extractant which extracted the exchangeable and partly water-soluble potassium in soils gave a significant correlation

between the available potassium and crop responses showing thereby that Morgan's method is a suitable one for the estimation of available potassium in Dumka soils. Similarly with Chalakudi soils, the % K saturation gave the highest correlation significant at 1% level. Other methods too gave correlation coefficient significant at 5% level thus showing that % K saturation is a suitable indication for available potassium in Chalakudi (Kerala) soils.

Indian Agric. Res. Inst., P. K. OOMMEN.  
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### NOTE ON THE VARIATION IN THE LENGTH OF THE CUCUMIS VIRUS

THE physical dimensions are known to be characteristic of a virus. It is well known that the minor dimension is constant in the rod-shaped virus particle while the major dimension is variable. The object of this communication is to record the variation in the length of the Cucumis Virus-2C as observed under the electronmicroscope. The specimen was mounted by placing small drops of the virus suspension on formvar filmed grids, shadowed with palladium and photographed under a Philips 100 kv electronmicroscope.

The particles have a width of approximately 250 Å. In the absence of freeze-drying method and in the absence of a field in which a number of particles lie side by side, an exact measurement of the width of the particles is rather difficult. Fig. 1 shows a great variation in the length of the particles, as also end to end aggregation. This aggregation of the particles is often very compact and simulates the appearance of a single long unbroken one. This leads to inaccuracies in the measurement of the exact length of the particles. Particles having a length between 0-500 Å, 500-1000 Å and so on up to 13000 Å were placed in groups. Fig. 2 gives the length distribution of 1500 particles measured. It is observed that 72.9% particles have a length between 1000-5000 Å, showing that

particles in this range are more stable irrespective of their mode of formation by aggregation or breaking up. The statistical mean length of particle is  $3161.2 \pm 63.2$  Å. The shortest and



FIG. 1

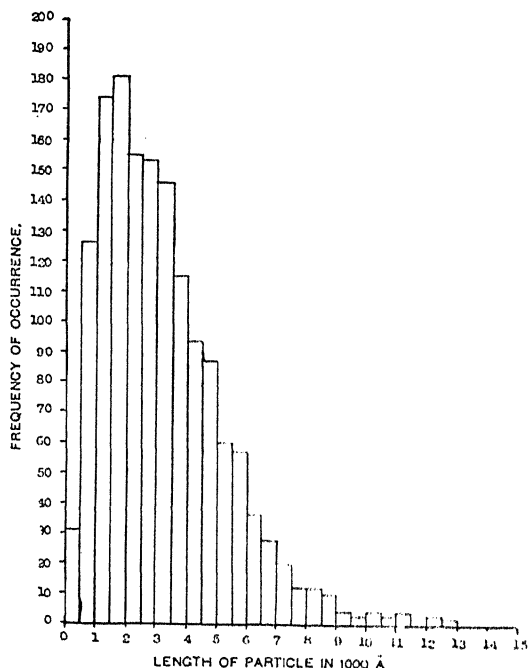


FIG. 2

longest particles have a length of 200 Å and 12,900 Å respectively. The particles below 500 Å and above 6000 Å are small in number.

The authors are thankful to Dr. C. Dakshinamurti for his encouragement and to Mr. G. P. S. Anand of the Division of Mycology and Plant Pathology for supplying the virus material.

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### THE FORMATION OF "MICROAPLANOSPORES" IN *COMPSOPOGON COERULEUS* (BALBIS) MONTAGNE

Born Thaxter<sup>1</sup> and Brühl and Biswas<sup>2</sup> have reported the occurrence of what Thaxter calls "microaplanospores" in *C. coeruleus*. The former has not only described the formation of these spores, but has also presented evidence that they are liberated from the sporangia in a manner similar to that of the "macroaplanospores". Yet the figures given by Thaxter are not very convincing and appear more like an encrusting epiphyte. Even less convincing is the account of Brühl and Biswas. Hence I desired to examine Thaxter's material of *Compsopogon* from Florida. This I was enabled to do by the kind courtesy of Dr. I. McKenzie Lamb of the Farlow Herbarium of Harvard University, who kindly sent me herbarium material of Thaxter's collections. The specimens examined were: two specimens from Daytona, collected by Thaxter in January 1898 and three specimens from Coconut Grove, Florida, also collected by Thaxter in October 1897. Also available was a specimen from Ballygunj, Calcutta, collected by Biswas in January 1922.

Fragments of the herbarium specimens were re-expanded and mounted whole or sectioned for microscopic examination. The "microaplanosporangia" were met with only on the older corticated axes of the alga, although Thaxter has figured their occurrence on the uncorticated axis. One of the cortical cells shows a small protuberance on the surface and the protruding portion is separated by means of a slightly curved wall (Fig. 1). The small cell so separated forms the initial cell of a "sorus". This cell then undergoes anticlinal divisions (Fig. 2) or divisions by slightly oblique walls to form a cluster of "microaplanosporangia". The division is at first so regular



that one may, on examining the surface of the filament, find small compact groups of two, four or eight sporangia. As the initial cell divides, the underlying parent cell enlarges and pushes

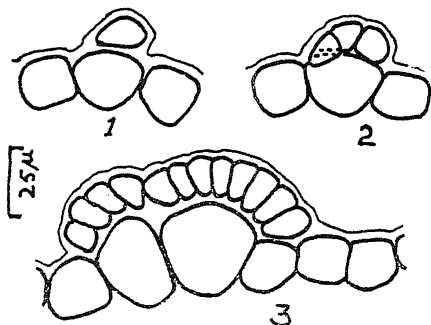


FIG. 1-3

outwards, carrying the sorus on its outer surface. When seen in cross-section of the filament, the parent cell is distinguished from other cortical cells by its larger size and protruding nature and is surmounted by a layer of sporangia. Frequently, this development takes place on two or more adjacent cortical cells (Fig. 3) which render the sorus extensive. The sporangia were 8-9  $\mu$  across.

The enlargement of the parent cell during the division of the sporangial initial cell is reminiscent of the enlargement of the axial cells of the thallus during the divisions of the cortical cells. This leads one to wonder whether the "sorus" of "microaplanosporangia" is not a modified branch of the thallus.

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#### ISOLATION OF KERATINOMYCES AJELLOI FROM SOIL IN INDIA

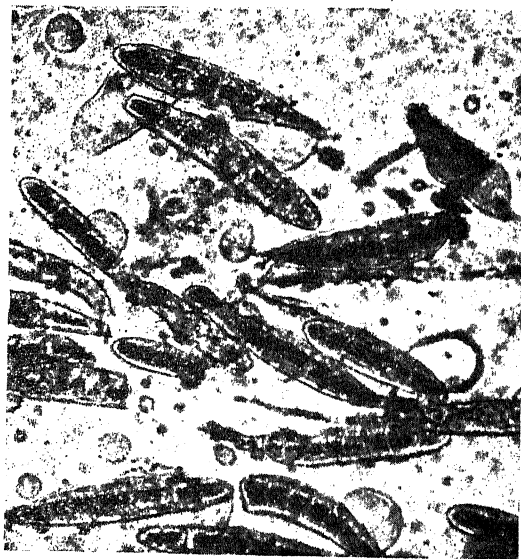
THE keratinophilic fungus, *Keratinomyces ajelloi* was first described by Vanbreuseghem<sup>5</sup> isolated from four out of seven Belgian soil samples by employing the hair-bait technique. Since then, using similar techniques, the fungus has been reported from several countries by different workers (Ajello,<sup>1</sup> Dawson *et al.*,<sup>2</sup> and Meinof *et al.*<sup>4</sup>). Its pathogenic nature as a dermatophyte was shown by its incitement of ringworm lesions on a captive Malabar giant squirrel

(*Ratufa indica malabarica*) by Georg *et al.*<sup>3</sup> and further confirmed by experimental inoculations in guinea pigs. Recently the perfect stage of *K. ajelloi* has been shown to be *Arthroderma uncinatum* a member of Gymnoascaceae by Dawson and Gentles.<sup>2</sup>

From a soil sample collected in Rishikesh by Dr. B. B. Gokhale, *Keratinomyces ajelloi* was isolated by employing the hair-bait technique. Its isolation from soil in India is of interest not only as a new addition to the fungi of India but also as a potential pathogenic fungus.

The soil sample was baited with a layer of sterile human-hair in petri-dishes, and moistened with 15-20 ml. of sterile distilled water. The plates were incubated at 24° C. in a dark cupboard and examined periodically. The yellowish-white growth on hair become visible after 6-9 days of incubation. The hair filaments when observed under microscope showed abundant cylindric to fusiform, 8-12 septate macroconidia. The hairs were then inoculated on Sabouraud-chloramphenicol-cycloheximide-agar from which the fungus was isolated in pure culture.

Growth of the colony at the end of 7 days was 1.8 to 2.5 cm. in diameter, flat, powdery, cream to orange in colour. Reverse of the young colony was slightly yellowish but tending to bluish-black with age. No diffusible pigment reported by Vanbreuseghem was noted.

FIG. 1. Macroconidia of *K. ajelloi*,  $\times 750$ .

Microscopic examination of the colony showed mycelium was septate, branched, hyaline, bearing numerous macroconidia (Fig. 1). Macro-

conidia were hyaline, cylindric to fusiform, thick-walled, smooth, 8-12 septate measuring  $18-60 \times 3.5-10 \mu$ . Few microconidia were seen in this isolate similar to those described by Georg *et al.*

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#### MEHLIS'S GLAND COMPLEX IN THE CATTLE LIVER FLUKE *FASCIOLA* *GIGANTICA* COBBOLD

EVER since Stephenson<sup>1</sup> endeavoured to unravel the complicated arrangement of the female reproductive ducts embedded in the enormously developed Mehlis's gland in *Fasciola hepatica* L. there has been continued interest to solve the problem as comprehensively as possible. Kouri and Naus<sup>2</sup> even earlier had by histological methods arrived at some interesting conclusions. However, Yosufzai,<sup>3</sup> in his attempt to revive the older concept that Mehlis's gland (the so-called shell-gland) secretes the bulk of egg shell material has described the ducts in a manner best fitting his way of thinking. Hanumantha Rao,<sup>4</sup> and Smyth and Clegg<sup>5</sup> not only confirmed the findings of Stephenson but also gave much needed additional information and showed that the interpretation given by Yosufzai is no longer tenable. Even so, the problem of Mehlis's gland in helminths is far from settled, especially the chemical nature of the secretion has been tantalizingly elusive although on the basis of histochemical tests a phospholipid nature is evident.<sup>6</sup>

In this connection investigations on other species of *Fasciola* should be of interest. We have recently directed our attention to *F. gigantica* Cobbold collected from the livers of cattle at Hyderabad, Andhra Pradesh, India. In the arrangement of the ducts (Fig. 1) this trematode basically resembles *F. hepatica*. The interesting part of the system of ducts is the occurrence of an uterine valve (UT. V). The ootype (OT) which is clearly cellular admits the strongly periodic acid-Schiff positive secre-

tion of Mehlis's gland into the lumen throughout its extent (Fig. 2). At its commencement the ootype is joined by the short ovovitelline duct (OV. V). The Laurer's canal (LC) emerges from the oviduct and opens out on

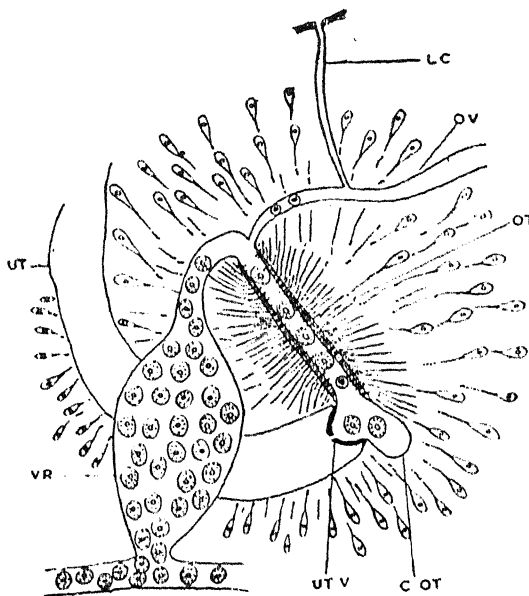


FIG. 1. Diagram showing the relationship of the female reproductive ducts and Mehlis's gland in *Fasciola gigantica*. C.O.T, caecum of ootype; LC, Laurer's canal; OT, ootype; OV, oviduct; UT, uterus; UT.V, uterine valve; VR, vitelline reservoir.

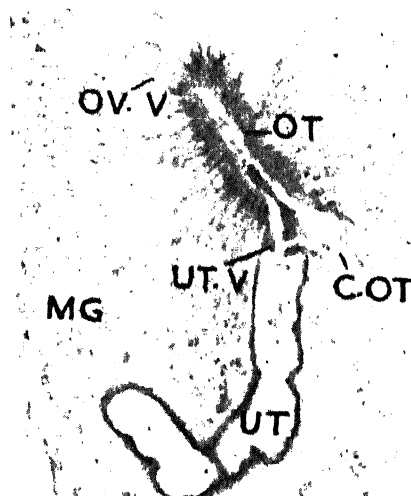


FIG. 2. Section of *Fasciola gigantica*, passing through Mehlis's gland (MG) showing ovovitelline duct (OV.V), ootype (OT), caecum of ootype (C.O.T), uterine valve (UT.V), and uterus (UT). Note the strongly periodic acid-Schiff positive secretion entering through the cellular ootype wall and the release of cells through the uterine valve (PAS-malachite green staining).

the dorsal side. At the other end the ootype opens into the uterus before giving off a short blind caecum (C. OT). It has now been ascertained that such a caecum is characteristic of *F. hepatica* also. This feature was not reported previously. The uterine valve appears to be funnel-like but without a stem. There is just room enough for the vitelline cells and the ova to pass through the ootype. In the case of *Fasciolopsis buski* it had already been indicated by Goddard<sup>7</sup> that the ootype is a straight cylindrical tube with its wall made up of tall columnar cells. A similar situation may be expected to occur in almost all cases. During their passage the cells are brought into close contact with the secretion of Mehlis's gland; indeed they come into physical contact with the ootype wall but the release of the egg shell precursors and the construction of the shell occur in the proximal region of the uterus and not in the ootype.

It is now becoming more and more clear that the place of construction of the egg shell in a majority of trematodes and cestodes is the region of the uterus, adjoining the Mehlis's gland associated ootype. It would appear that the ootype in helminths is a narrow canal and the lumen therefore cannot be justifiably called a chamber.

One of us (R. M.) thanks the University Grants Commission for a scholarship. Appreciation is extended to Professor P. N. Ganapati for facilities and interest.

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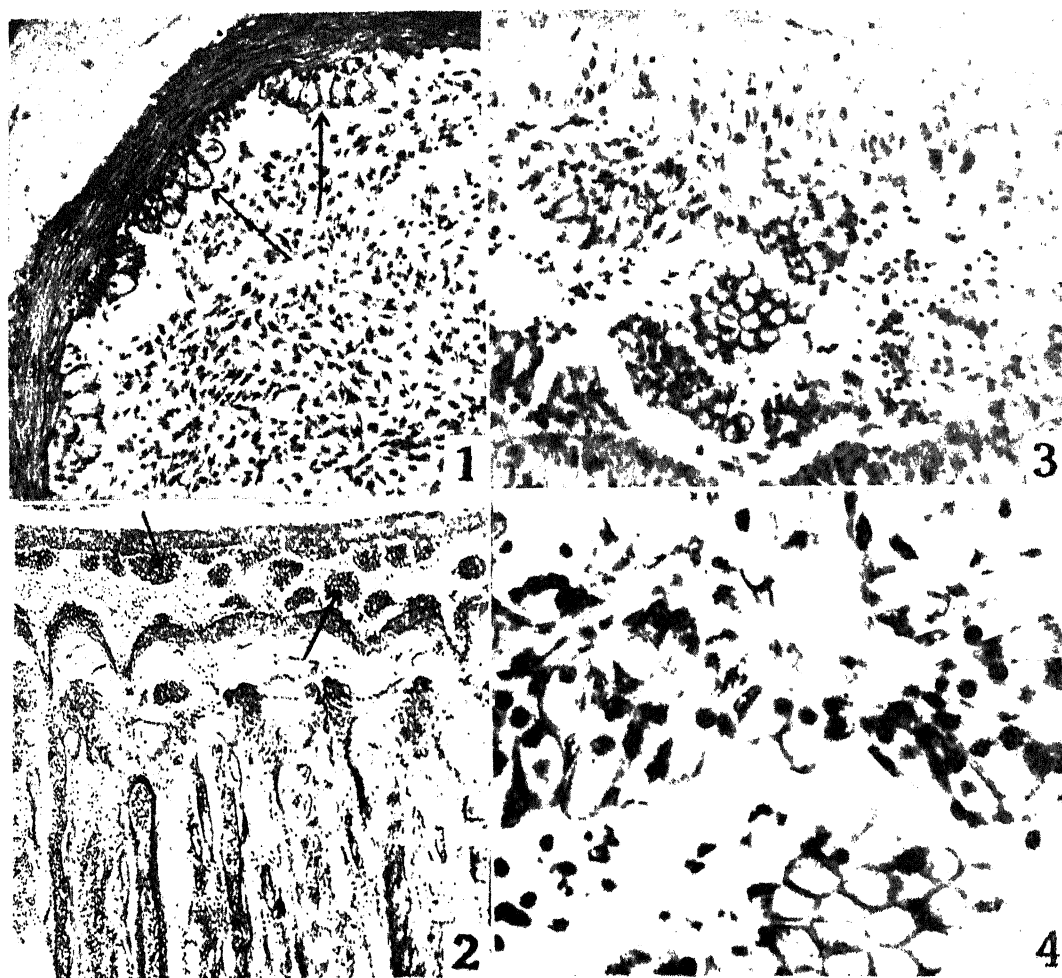
#### HAEMOPOIETIC ACTIVITY IN THE GILLS OF CERTAIN TELEOSTS

THE lymphatic and the myeloid organs are the main sources of new blood cells in the vertebrates. In the broadest sense, the hemopoiesis involves the bone marrow, spleen, thymus, lymph nodes, connective tissue and the vascular and the lymphatic systems.<sup>1-6</sup>

Danchakoff (1916), Doan (1932), Maximow (1927), Downey (1938) and, more recently, Maximow and Bloom (1960) have come to the conclusion that one primitive multipotential cell, called hemocytoblast, provides the common stem cell for all kinds of blood cells. This has given rise to the 'Unitarian' theory of hemopoiesis as against the 'Dualistic' or the 'Triallistic' theories of blood formation.

Several hematologists have reported about the hemopoietic activity of the endothelium of the blood vessels. Maximow and Bloom (1960) write that "in early embryonic stages the endothelium of the blood vessels is identical in its potencies with the common mesenchymal cells. Thus in the yolk-sac vessels and in the caudal portion of the aorta, the endothelial cells form clusters of hemocytoblasts." The endothelial cells of the inter-sinusoidal capillaries in the bone marrow of young animals show marked hypertrophy and hyperplasia before the formation of the erythrocytes.<sup>1</sup> Small isolated islands of erythroblasts develop from these first stem cells. After maturing within the capillaries, the erythrocytes were said to be carried directly into circulation.

The present author<sup>7</sup> while studying the micro-anatomy of the gills of several freshwater teleosts found that the endothelium of the afferent blood vessels of certain of these fishes, belonging to the family Cyprinidae, show marked hemopoietic activity. In the first stage of development, the endothelial cells become hypertrophied and multiply to form clusters of cells, hanging freely into the lumen of the blood vessels. Later on, each such cluster becomes detached from the main stalk and floats freely into the lumen as a blood island. In *Catla catla* groups of such stem cells—the haemocytoblasts—are seen attached to the inner wall of the afferent blood vessel of the gill (Fig. 1). In a section of a gill of *Labeo rohita*, passing along its afferent vessel, the endothelium of the blood vessel is seen in different stages of haemopoietic activity (Fig. 2). The haemocytoblasts developing in clusters from the wall project freely into the lumen of the blood vessel and, later on, the bunch of cells becomes constricted off from the stalk and floats freely as a blood island in the lumen (Figs. 3 and 4). When such an island or cluster of blood cells happens to be cut across, it wears a honey-combed appearance (Fig. 4). The nuclei take a deep stain with haematoxylin and may lie excentrically. The cytoplasm is slightly eosinophilic and fibrillar in character. These cells will eventually differentiate into the future erythrocytes. Here is a case to show



FIGS. 1-4. Fig. 1. Photomicrograph of a section of a gill of *Catla catla* showing groups of hemocytoblasts attached to the inner wall of the afferent blood vessel,  $\times 340$ . Fig. 2. Photomicrograph of a section of a gill of *Labeo rohita* showing clusters of hemocytoblasts and blood islands in the lumen of the afferent blood vessel,  $\times 40$ . Fig. 3. An enlarged view of Fig. 2 showing one of the clusters of hemocytoblasts and the blood islands,  $\times 400$ . Fig. 4. A highly magnified view of a portion of the above showing the details of the structures of the hemocytoblasts and the blood island,  $\times 1,000$ .

that in some freshwater fishes blood cells originate intravascularly also from the endothelium of blood vessels belonging to the gills.

My thanks are due to Professor A. B. Misra of Banares Hindu University for his valuable suggestions.

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ON AN ADDITIONAL FACTOR OF THE  
HEPATIC PORTAL SYSTEM,  
ADDITIONAL PULMONARY VEINS,  
AND A CORRESPONDING VENOUS  
UNIT OF THE SEGMENTAL ARTERIES  
IN COMMON GARDEN LIZARD,  
*CALOTES VERSICOLOR* DAUD.

In *Calotes versicolor*, the ventral abdominal vein, which enters the liver after trifurcation, receives the hepatic portal vein a little below the level of the left lobe of the liver. It is formed of usual factors, viz., gastric, pancreatic, splenic and mesenteric veins, as described by previous authors in different lizards. In addition to these, a prominent vessel, formed by some conspicuous units from the wall of the gut, directly enters the liver at its anterior third on the left side.

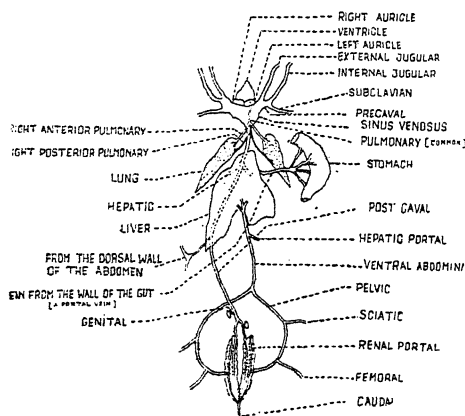


FIG. 1. Ventral view, position and size ( $\times 5$ ) of sinus modified.

The present author records the presence of pair of pulmonary veins on each side. The anterior pulmonary vein is more prominent than the posterior pulmonary vein. The anterior pulmonary comes out from the centre of the basal region of the lung, whereas the posterior pulmonary arises from the inner and the lower basal surface of the lung. The two posterior pulmonary veins unite below the level of the union of the two anterior pulmonaries.

From the mid-dorsal wall of the abdomen, a vein comes to join the post-caval inside the mass of the right lobe of the liver at its posterior end. This vein is formed by the union of two factors, one proximal and one distal, pouring the contents in the post-caval.

The additional gastric vein, from the wall of the gut and directly entering the liver on the left side, should be regarded as an additional

factor of the hepatic portal system, and is, probably, indicative of the absorptive capacity of the stomach.

The presence of the two pulmonary veins on each side may be said to correspond with the two pulmonary arteries of the same side, as has been told earlier by Bhatnagar (1960) in *Varanus monitor*. This is an advantage to the possessor and is, probably, in response to the nature of its long lung.

In view of a large number of segmental or intercostal arteries arising from the dorsal aorta, there necessitates the presence of at least a large corresponding vein from the mid-dorsal region, which is formed by the union of two median factors, one proximal and one distal, pouring the contents in the post-caval. This offers an explanation for the existence of the vessel from the mid-dorsal wall of the abdomen.

S.C.S. Government College, G. S. GHOSH.  
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OCCURRENCE OF ZONAL LEAF SPOT  
OF COFFEE CAUSED BY *CEPHALO-  
SPORIUM ZONATUM* IN INDIA

SINCE 1957, the writers have been observing the incidence of a leaf-spot disease on robusta coffee growing in a small patch in Crawford area at Coffee Research Station, Balchonnur. During September 1961, specimens of diseased leaves of arabica coffee collected from an estate in Mudigeré coffee zone, Mysore State, were received for examination. The symptoms on these specimens were identical with those observed on robusta coffee at this station. The characteristics of the disease were quite distinct from those of other leaf-spot diseases affecting coffee in this country.

The spots are irregular in shape, varying in size from 1 to 6 cm. in diameter, greyish-brown with dark-brown concentric rings which are often incomplete. The lower surface of the spots are covered with a thin weft of white mycelium extending radially up to 5 mm. beyond the margin of the spots with a somewhat pulverulent greyish-white fructifications of the fungus.

The mycelium is composed of loosely inter-twining, hyaline to subhyaline, septate, branched, recumbent hyphae, 2.5-3  $\mu$  in diameter giving rise to conidiophores either directly or on short stipes. The conidiophores are hyaline, slightly wider at the base and gradually tapering towards the tips, and measure 47-77 (67.8)  $\mu$  in length. The conidia, borne acriogenously and successively, are hyaline, elliptic to short fusiform, sometimes slightly curved, continuous and measure 4.2-8.4 (6.0)  $\times$  1.8-2.5 (2.0)  $\mu$  in size. The detached conidia collect in slime drops at the tips of the conidiophores in globose false heads.

Successful artificial inoculations on leaves of *Coffea arabica* and *C. robusta* using the above fungus established its pathogenicity.

Based on the gross morphology and size of the spores, the fungus was identified as *Cephalosporium eichhorniae* Padwick. While confirming this identification, Mr. Deighton, Commonwealth Mycological Institute, England, observed that *C. eichhorniae* and *C. fici* Tims and Olive are synonyms of *C. zonatum* Sawada, and that this fungus seems to be quite widely distributed in the wetter tropics on a wide range of host plants.

Zonal leaf-spot disease of coffee was first described from Puerto Rico in 1915 by Fawcett,<sup>1</sup> who ascribed the disease to an undetermined species of *Cephalosporium*. Deighton,<sup>3</sup> while reporting the disease from Sierra Leone, attributed it to *Cephalosporium eichhorniae*. The disease has been known to occur in Peru,<sup>1</sup> French West Africa,<sup>2</sup> and Lesser Antilles.<sup>5</sup> This report records the disease on coffee for the first time in India. The disease has not so far attained a major status in this country.

Diseased specimens of *Coffea arabica* leaves have been deposited in the Herbarium, Commonwealth Mycological Institute, England—Acen. No. 89602.

The writers are grateful to the Director, Commonwealth Mycological Institute, England and to Mr. Deighton, Assistant Mycologist of the above Institute, for confirming our identification of the fungus and to Dr. N. G. Chokkanna, Director of Research, Coffee Research Station, Balehonnur, for encouragement during the investigations.

Coffee Research Station, T. R. NAG RAJ.  
Chikmagalur Dist., K. V. GEORGE.  
Mysore State, October 20, 1961.

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## INHERITANCE OF GRAIN SIZE IN RICE

INHERITANCE of grain size in rice was studied, taking 4 varieties of rice with different types of grains, the varieties being two Aus namely Charnock and Dhairai and two Aman, namely Patnai-23 and Bhasamanik. The grain of Dhairai is short and bold, of Charnock fine, of Patnai-23 long and bold and of Bhasamanik medium. Crossings were made between Aus and Aman varieties. Hybrid seeds were sown in 9" pots with an equal quantity of soil mixed with one-eighth part of cowdung manure. In all 10 hybrid plants in four different combinations were obtained. Grain size of the 10  $F_1$  plants and their parents were studied, the reciprocals were found to produce identical grains. The sampling of the grain from each plant for measurement of length and breadth was very carefully done to reduce variation within the plant.

It was found that length and breadth of the grains produced in three combinations of  $F_1$  plants were more or less intermediate between the parents and in the fourth (Charnock  $\times$  Bhasamanik) the grain size of the  $F_1$  plants was found to exceed the mean grain size of their parents, an increase by 5% in length as well as breadth was observed (Table I). Intermediate nature in respect of  $F_1$  grain size was also obtained by some of the previous workers,<sup>1</sup> while others observed dominance of long grain character.<sup>2</sup>

In 1958, seed from  $F_1$  plants were grown in the field plots specially prepared according to usual agronomical practices for paddy cultivation and the grain size as measurements of length and breadth of grain was studied in each of the  $F_2$  plants. As in the  $F_1$  plants, in the  $F_2$  plants also, in the same three combinations the mean length and breadth of seeds were found to be intermediate between the parents and the limits of the  $F_2$  seeds mostly lay within their parental range. And in the fourth combination, i.e., Bhasamanik  $\times$  Charnock, where the cross was between grains of almost equal length the  $F_2$  mean grain length was found to exceed the parental mean; suggesting that the parents in this cross though phenotypically similar in length may be genotypically different.

In all the combinations, the frequency distribution both in respect of length and breadth

TABLE I  
Mean length and breadth of grains of  $F_1$  and  $F_2$  plants and their parents

Crosses	Average length of $F_1$ seeds (mm.)	Grain length mean of the two parents (mm.)	Average breadth of $F_1$ seeds (mm.)	Grain breadth mean of the two parents (mm.)
$F_1$ plants :				
Patnai-23 $\times$ Charnock	.. 9.29	9.35	2.49	2.40
Patnai-23 $\times$ Dhairai	.. 8.65	8.86	2.98	3.08
Bhasamanik $\times$ Dhairai	.. 7.92	7.88	2.78	2.81
Bhasamanik $\times$ Charnock	.. 8.75	8.37	2.22	2.13

Crosses	Average length of $F_2$ seeds (mm.)	Grain length mean of the two parents (mm.)	Average breadth of $F_2$ seeds (mm.)	Grain breadth mean of the two parents (mm.)
$F_2$ plants :				
Patnai-23 $\times$ Charnock	.. 9.71	9.97	2.60	2.51
Patnai-23 $\times$ Dhairai	.. 9.03	9.33	3.12	3.18
Bhasamanik $\times$ Dhairai	.. 8.08	8.11	2.95	3.00
Bhasamanik $\times$ Charnock	.. 8.84	8.75	2.39	2.33

of seeds was found to present a unimodal curve with or without transgressive segregation beyond the parental limits. These suggested that multiple genes may be involved in determining both length and breadth of grain and they are independent in their inheritance. Also, it seems that the extent of cumulative effect of the genetic complex influencing the grain size is different in the different varieties.

The slight variation in grain size as obtained for each parent during the two years of experiment appears to be due to the difference in their mode of culture. In 1957, they were grown in pots under a more restricted nutrition than the plants of 1958 which grew under normal nutritional condition of the field. So the potted plants produced smaller grains than the plants in the field.

I am much indebted to Professor P. K. Sen, Head of the Department of Agriculture, Calcutta University, for his valuable suggestions and encouragement.

Department of Agriculture,  
Calcutta University,  
Calcutta-19, August 9, 1961.

G. N. MITRA.

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### OLPIDIUM UREDINIS PARASITE ON PHAKOPSORA GREWIAE

*Olpidium uredinis* (Lagerh.) Fischer<sup>1</sup> is hyperparasitic within the uredospores of several rust species such as *Uredo aiae*, *Puccinia rahmni*, *P. violae*, *P. rubrum*, *P. levis* and *P. coronata*. Thirumalachar<sup>2</sup> reported it on the uredospores of *Hemileia canthii*.

The author collected leaves of *Grewia asiatica* Linn. infected with the rust *Phakopsora grewiae* (Har. and Par.) Cummins, originally from Allahabad, later on from Banaras also. The material collected from Allahabad is interesting as it had uredospores of the rust hyperparasitised with *Olpidium uredinis* (Lagerh.) Fischer. This observation adds to the list of the rust hosts attacked by this hyperparasite.

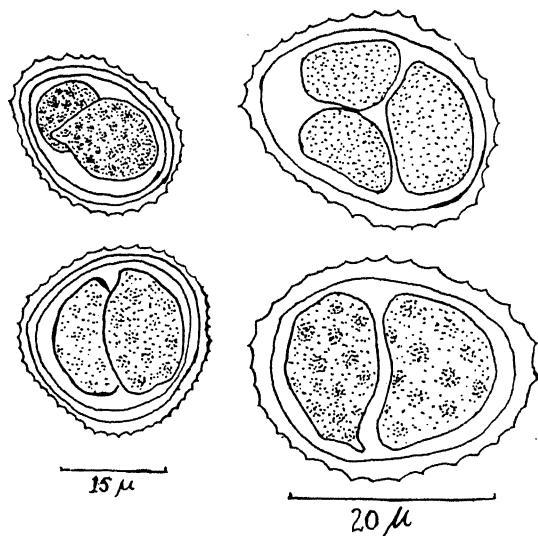


FIG. 1. Uredospores with sporangia.

#### DESCRIPTION OF THE PARASITE

Infected spores are without contents, sporangia formed within the uredospores, one to six in number, holocarpic, hyaline, ovate, spherical to subglobose. In two cases exit tubes were observed in the form of small papillae from the sporangia. Sporangia differ from hyphospores in having thin walls.

The author is grateful to Dr. R. Y. Roy for his helpful guidance and encouragement; to Prof. R. Misra for providing laboratory facilities; and to Dr. M. J. Thirumalachar for identifying the material and giving useful suggestions.

Department of Botany, MAHENDRA SHUKLA,  
Banaras Hindu University,  
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### A NEW SPECIES OF COLLETOTRICHUM

In the course of his mycological collection at Rewa (M.P.) the author encountered a leaf spot on *Capparis sepiaria* L. The disease first appears as minute spots on any part of the leaf, and gradually increases in size, they are brown and circular to irregular. The central region of the lesions becomes ash-coloured and on this acervuli appear as black dot-like structures. Spots rarely coalesce.

Examination of the lesions revealed the pathogen to be a *Colletotrichum* (Fig. 1).

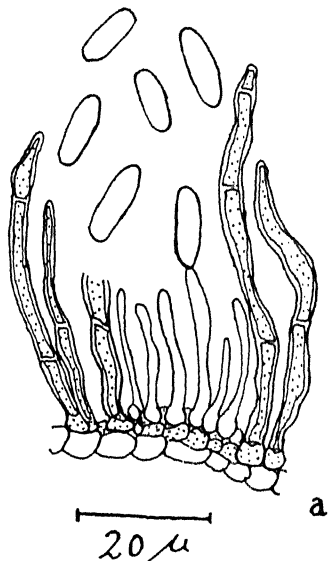


FIG. 1. Acervulus showing conidiophores, setae and spores.

Acervuli broad, superficial,  $46.2-99 \mu$  in width. Setae scattered in the acervulus, brown, simple and septate. Conidiophores hyaline, simple and short. Conidia hyaline, single-celled, cylindrical,  $13.2-16.5 \times 3.3-6.6 \mu$ , average  $15.2 \times 4.8 \mu$ .

The specimen was examined by Mr. Sutton, Assistant Mycologist, Commonwealth Mycological Institute, Kew, who reports, "Apparently none recorded on this host. The spores are sufficiently distinct, I think, to keep this species separate from *Glomerella cingulata* (conidii) for the moment". It does not seem to match with any of the recorded species of *Colletotrichum* and so far none have been recorded on *Capparis sepiaria* L. It is, therefore, being presented here as a new species, *Colletotrichum capparidis*.

*Colletotrichum capparidis* HASIJA SP. NOV.

Acervuli lati, superficiales,  $46.2-99 \mu$  lati, Setae dispersis per acervulum, brunneis, simplicibus septatis; conidiophori hyalini, simplices, breves, conidia hyalina, unicellularia, cylindrica,  $13.2-16.5 \times 3.3-6.6 \mu$ , mediet.  $15.2 \times 4.8 \mu$ .

In foliis viventibus *Capparidis sepiariae* L. ad Rewa in India mense septembri, 1960, leg. Hasija.

The type specimen has been deposited in the Herbarium of the Commonwealth Mycological Institute, Kew, No. 83933.

The author expresses his grateful thanks to Dr. G. P. Agarwal, Department of Botany, Mahakoshal Mahavidyalaya, Jabalpur, for his valuable suggestions and encouragement. Thanks are also due to the Director and Mr. Sutton of the Commonwealth Mycological Institute, Kew, for help in the identification of the species and to Prof. H. Santapau for the Latin diagnosis of the new species.

Department of Botany, S. K. HASIJA,  
Mahakoshal Mahavidyalaya,  
Jabalpur, August 24, 1961.

### OCCURRENCE OF A SERIOUS DISEASE OF SPINACH FROM INDIA

*Cercospora beticola* Sacc.<sup>2</sup> and *Cladosporium variable* (Cooke) de Vries<sup>1</sup> have been reported to cause severe leaf-spot diseases in smooth and savoy leaf type varieties of spinach (*Spinacea oleracea* L.) respectively from Rajasthan. During Rabi (October-March), 1959-60, a severe leaf spot disease of smooth leaf type spinach was noticed in the fields around Ajmer (Rajasthan) which had different symptoms. The infection was confined only to the leaves and numerous pale-brown, circular spots, 5-10 mm. in diameter with dark fruiting bodies of the pathogen arranged in concentric rings developed on them. In early stages, the infection appeared as light-



yellow specks which later increased into spots and coalesced. The affected leaves shrivelled and dried up.

The pathogen has globoid to conic, membranous, typically dark, sub-epidermal ostiolate pycnidia ranging from  $64.8-162.0\mu$  in diameter (Fig. 1); short simple conidiophores and globose to ovoid, hyaline, unicelled conidia, measuring  $3.0-6.4\mu \times 2.4-3.2\mu$  (mean  $4.8\mu \times 3.2\mu$ ) (Fig. 1).

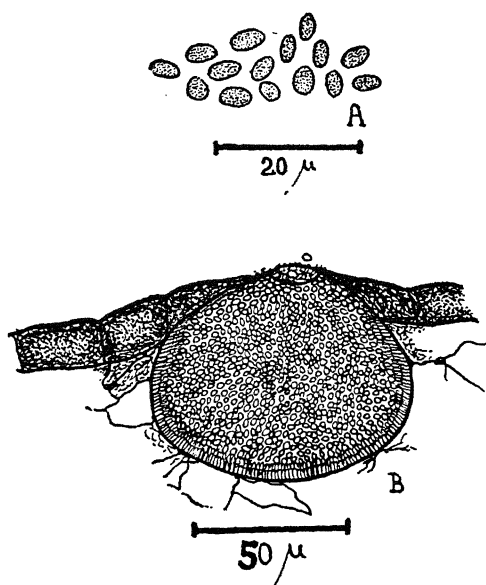


FIG. 1. *Phyllosticta spinacea* Zamm. A, Conidia; B, Pycnidium.

The morphological characters of the fungus under study confirm it to be *Phyllosticta spinacea* Zamm. This appears to be the first record of the pathogen on spinach from India.

Grateful thanks are due to Shri Samarth Raj, Director of Agriculture, Rajasthan, for facilities and to Dr. N. Prasad, Principal, S. K. N. Government College of Agriculture, Jobner, for guidance.

Plant Pathology Section,  
Deptt. of Agriculture,  
Rajasthan, Udaipur,  
August 17, 1961.

R. L. MATHUR.  
J. P. AGNIHOTRI.  
R. N. S. TYAGI.

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## REPORT OF A *THIELAVIA* FROM THE RHIZOSPHERE OF *VETIVERIA ZIZANIODES* NASH.

THE present fungus was isolated from a grass plot of Varanasi having *Vetiveria zizaniodes* Nash. as the dominant grass species. The plot is situated in a hilly region and is surrounded by hillocks. The area is low lying and remains submerged under water for about four or five months in a year between July and November. The fungus was isolated from 0.6" and 7.12" depths. The soil is sandy, mixed with small pieces of stones, pH of the soil is 7.2 throughout the profile.

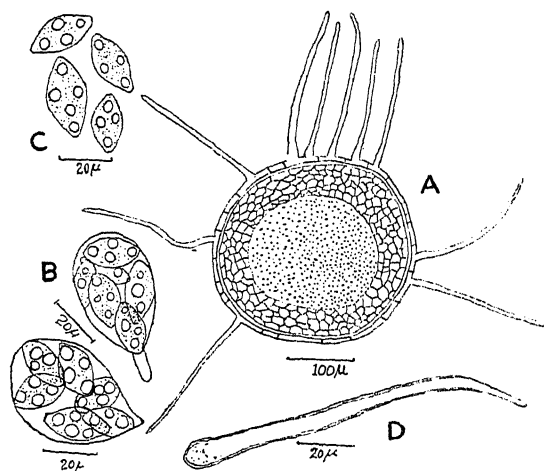


FIG. 1. *Thielavia setosa* Dade. A, a perithecium; B, asci; C, ascospores; D, a seta.

### CHARACTER OF THE FUNGUS

Colonies on Waksman's agar medium growing rapidly at  $28^{\circ}\text{C}$ ., floccose with white aerial tufts of septate hyphae; hyphae varying from  $3.6-5.4\mu$  in diameter. Perithecia formed after a week after inoculation; perithecia produced on the aerial hyphae, at first hyaline and soft, becoming black and brittle at maturity, globose, with appendages around, asci bearing region distinct after ten to twelve days with distinct thick wall at maturity, varying from  $240-400\mu$  in diameter; appendages hyaline in young stage, becoming brownish at maturity, straight or slightly curved, with swollen base, and tapering apex, thick-walled,  $72-230 \times 3.7-7.2\mu$ ; asci club-shaped, eight-spored,  $30.54 \times 27-32.4\mu$ ; ascospores olivaceous green with dense contents at the young stage, becoming black at maturity, broadly elliptical, broader in the centre, with characteristic truncate ends,  $21.6-28.8 \times 10.8-14.4\mu$ .

The remarkable features of the fungus are the production of brittle, black perithecia with straight or slightly curved appendages around, and ascospores with truncate ends. Amongst the so far described species, it resembles *T. setosa* Dade in having perithecia with appendages and in the size of the ascospores but differs from it in the following respects: (i) absence of the aleuriospores as described by Dade<sup>1</sup> (1938), (ii) production of mature perithecia and ascospores in pure culture without requiring any 'commensal', and (iii) bearing ascospores with truncate ends. Though these two fungi are not identical, they are at least closely related and tentatively it is proposed as *T. setosa* Dade.

The author is grateful to Dr. R. Y. Roy for his valuable guidance and to Prof. R. Misra, for providing the laboratory facilities. He is thankful to Dr. A. C. Stolk of the Centraal-bureau Voor Schimmelcultures, Baarn, for kind suggestions and to the Government of India for the financial help.

Botany Department,  
Banaras Hindu University,  
Varanasi-5, August 15, 1961.

R. S. DWIVEDI.

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#### A PARTIAL CHLOROPHYLL DEFICIENCY IN *NICOTIANA TABACUM* L.

REPORTS of spontaneous occurrence of mutants for different degrees of chlorophyll-deficiency in the cultivated species of *Nicotiana* and *N. tabacum* in particular are not as frequent as in the other related genera.<sup>1-5</sup> In a group of flue-cured tobacco varieties obtained from China a variety 'Kwang' was found to possess yellow leaves from the early stages of growth.<sup>6</sup> The leaves turned green with the onset of reproduction. Since such partial chlorophyll deficient types are of interest in the development of flue-cured strains suitable for the heavy soils where proper ripening of the leaf is a problem, a genetic study of this character was undertaken. This paper summarises the results of this study.

The variety Kwang was crossed with Chatham which is a flue-cured variety with normal green leaves. The  $F_1$  was normal. The segregation in the  $F_2$  and back-crosses is presented in Table I.

The counts of seedlings were taken in the nursery in sparsely sown beds to avoid competition between seedlings. The data suggest that the character is controlled by duplicate factors. But there is a definite departure from the expected ratio of 15 green : 1 yellow in the  $F_2$ 's and 3 green : 1 yellow in the back-

cross to Kwang. All the three independent  $F_2$  families were homogeneous for the deficiency ( $X^2$  for heterogeneity/2 df. = 0.1439;  $P = 0.90-0.95$ ). The yellow leaved segregants as well as the Kwang parent were definitely poorer in growth compared to the normals and the deficiency of the recessive class was more accentuated with advance in the age of the seedlings after the first four weeks. The growth data under field conditions are presented in Table II.

In the early stages (4 weeks after sowing) the mean height of Kwang was less than half of the normal seedlings, while the leaf number was nearly  $1\frac{1}{2}$  times that in Chatham. Therefore it appears that the over-production of leaves compared to its slow growth and inhibition in leaf size are to some extent responsible for its lethality. The difference in height continued even for eight weeks after sowing. However, the normal segregants had greater number of leaves than the yellow segregants by this time. The behaviour of the Kwang parent and yellow-leaved segregants was parallel in all the stages.

To examine whether gametic or zygotic lethality was operating to cause the observed deficiency,  $F_2$  progenies were raised in petridishes at a controlled temperature of 70-72° F. Clear segregation was obtained into 236 green : 15 yellow which established that gametic lethality was not involved. Pollen abortion or meiotic abnormalities followed by seed abortion were not detected either in Kwang or in the  $F_1$ . Germination tests were conducted at 70-72° F. and 80-82° F. to find out the stage at which lethality sets in. The results showed that Kwang lags behind Chatham in germination by at least 14 hours with just 4% to 20% germinating on the first day as compared to over 90% in Chatham. In the  $F_2$ , nearly 20% of the seeds lagged behind by 2 days in germination, compared to the rest.

Anatomical studies of the leaf showed that the number of layers of palisade were the same in both yellow and normal. However, the chloroplasts were larger and fewer in Kwang.

The occurrence of types with yellowish green leaves in *Nicotiana tabacum* and *Nicotiana rustica* with sufficient viability to reach production is known in natural and introduced populations of *N. tabacum*.<sup>2,4,6,9,10</sup> The variety Kwang is semi-dwarf with early flowering (42 days) compared to 85-90 days to flower in Chatham. The data indicate that the deficiency of the segregating populations was due to (a) slow germination and poor initial growth of yellow seedlings and (b) chlorophyll deficiency which

TABLE I  
Segregation for yellow leaf in the  $F_2$  and back-crosses of Chatham  $\times$  Kwang

Generation	Green	Yellow	Expected yellows	$\chi^2$	P	Deficiency of recessives
Chatham $\times$ Kwang						
$F_2$ family (15 green : 1 yellow) 1	1375	73	90.5	3.6095	0.05 - 0.10	19.3%
" 2	1623	83	106.6	5.5731	0.01 - 0.02	22.1%
" 3	2168	109	142.5	8.4004	0.001 - 0.01	22.9%
Chatham $\times F_1$	1410	0	0	..	..	..
Kwang $\times F_1$ (3 green : 1 yellow)	392	85	121.8	14.8247	<0.001	30.2%

TABLE II  
Growth data of yellow and green segregants four (A) and eight (B) weeks after sowing in the cross Chatham  $\times$  Kwang

A (4 weeks after sowing)				B (8 weeks after sowing)			
Material	Height in cm.	No. of leaves	Area of the largest leaf in sq. mm.	Material	Height in cm.	No. of leaves	Area of the largest leaf in sq. cm.
Chatham	2.98 $\pm$ 2.00	4.80 $\pm$ 1.61	94.25	Chatham	9.30 $\pm$ 1.04	4.30 $\pm$ 0.26	132.15 $\pm$ 20.56
Kwang	1.16 $\pm$ 0.13	7.60 $\pm$ 0.16	38.25	Kwang	2.60 $\pm$ 0.19	5.30 $\pm$ 0.21	40.48 $\pm$ 3.82
†				$F_1$ Chatham $\times$ Kwang	11.45 $\pm$ 1.15	4.20 $\pm$ 0.25	85.70 $\pm$ 12.32
$F_2$ Chatham $\times$ Kwang	2.58 $\pm$ 0.37	4.60 $\pm$ 0.16	74.25	$F_2$ Chatham $\times$ Kwang			
				Green	8.90 $\pm$ 0.99	6.30 $\pm$ 0.42	165.59 $\pm$ 30.99
				Yellow	4.86 $\pm$ 0.57	4.60 $\pm$ 0.27	17.19 $\pm$ 4.00
Kwang $\times F_1$ †	2.29 $\pm$ 0.39	6.50 $\pm$ 0.27	91.00	Kwang $\times F_1$			
				Green	10.68 $\pm$ 1.32	6.70 $\pm$ 0.30	165.64 $\pm$ 21.22
				Yellow	3.95 $\pm$ 0.71	6.20 $\pm$ 0.51	70.46 $\pm$ 17.58
Chatham $\times F_1$	2.79 $\pm$ 0.45	5.00 $\pm$ 0.37	100.32	Chatham $\times F_1$	9.15 $\pm$ 0.70	5.10 $\pm$ 0.38	118.41 $\pm$ 16.49

$F_1$  data not available.

† Green vs. yellow segregants were not clearly distinguishable at this stage.

sets in about four weeks after sowing in the yellow segregants, at a time when the normal seedlings commence shooting up in growth.

Central Tobacco Res. Inst., G. S. MURTY.  
Rajahmundry, B. R. MURTY.  
August 18, 1961.

## PRODUCTION OF PECTIC AND CELLULOLYTIC ENZYMES BY ARHAR WILT FUNGUS

WILT of Arhar caused by *Fusarium lateritium* f. *cajani* (Padw.) Gord. is one of the most important wilt diseases known in India, and causes severe losses to the crop throughout the country. Little is known about the physiology of host parasite interaction, and the mechanism of wilting in this disease. Hydrolytic enzymes have been found to play an important part in the pathogenesis of several wilt inducing plant pathogens including some species of *Fusarium*.<sup>1-5</sup> The present investigations were undertaken to study the role of enzymes in the pathogenesis of Arhar wilt fungus. This paper describes the results of preliminary experiments about production of pectic and cellulolytic enzymes by *Fusarium lateritium* f. *cajani* (Padw.) Gord.

To prepare samples for enzyme assay, a highly pathogenic isolate was cultured on Richard's solution which was modified by

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varying the carbon sources and adding 0.01% yeast extract in each case. The different carbon sources employed in the culture media were 3% sucrose and 1% carboxymethyl cellulose (C.M.C. 70 Hercules Powder Co.), filter-paper and citrus pectin (Sunkist growers, California). The fungus was also grown on sterilised pieces of Arhar stems, and roots suspended in water. The fungus was allowed to grow for 6 to 7 days in still cultures in 250 ml. Erlenmeyer flasks containing 50 ml. of liquid medium. The mycelium was then removed by filtering through a buckner funnel. The filtrate was centrifuged for 20 minutes at 5,000 r.p.m. The clear supernatant obtained after centrifugation was used as enzyme sample.

Polygalacturonase (P.G.) and Cellulase (C.x.) were assayed by measuring the loss of viscosity of substrates. The viscosity was measured in Ostwald viscometers. 2% sodium polypectate containing citric acid-sodium hydroxide buffer at pH 5.5 was used as a substrate for the determination of P.G. The substrate in cellulase assay was 1.2% carboxy methyl cellulose containing the above-noted buffer at pH 5.5.

Although all the culture filtrates obtained from sucrose and pectin containing media gave positive results for polygalacturonase production (Fig. 1), the enzymic activity was far

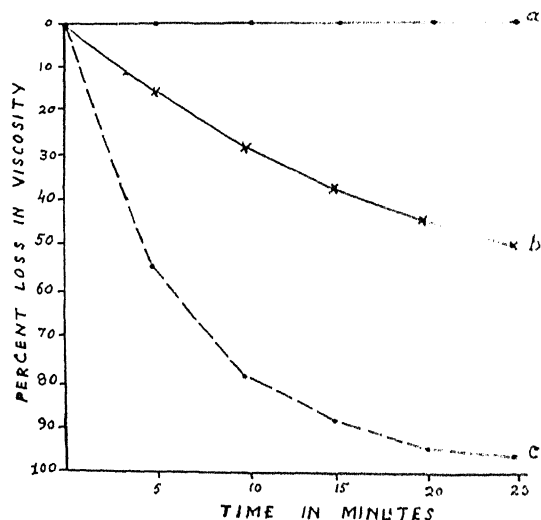


FIG. 1. Rate of loss in viscosity of 2% sodium polypectate caused by (a) heated culture filtrates; (b) nonheated culture filtrate containing sucrose; (c) nonheated culture filtrate containing pectin.

greater in culture filtrates obtained from the liquid medium containing citrus pectin. While almost no cellulase activity was detected in culture filtrates of the organism grown on

sucrose containing medium, significantly high cellulase (C.x.) was found in filtrates obtained from cellulose containing media (Fig. 2). Both

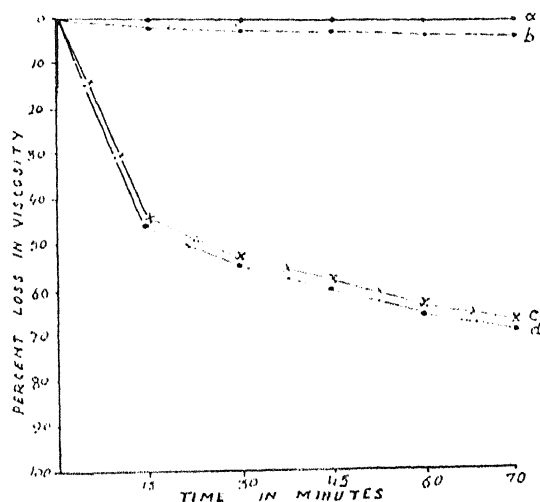


FIG. 2. Rate of loss in viscosity of C.M.C. caused by (a) heated culture filtrates; (b) nonheated culture filtrate containing sucrose; (c) nonheated culture filtrate containing filter paper; (d) nonheated culture filtrate containing C.M.C.

of these enzymes seem to be adaptive in this case as enzyme activity is considerably increased in presence of substrates (Table I).

TABLE I  
Effect of carbon source on enzyme activity

Enzyme	Carbon source	Activity*
P.G.	.. Sucrose	37
P.G.	.. Pectin	250
Cellulase	.. Sucrose	0
do.	.. C.M.C.	45
do.	.. Filter paper	41

\* Enzyme activity expressed as reciprocal of time for 50% loss in viscosity,  $\times 1,000$ .

Presence of P.G. and C.x. enzymes was also detected in culture filtrates of the pathogen grown on sterilized pieces of stems, and roots suspended in water. The enzyme activity was, however, relatively lower in these filtrates.

The results of these preliminary studies indicate that *Fusarium lateritium* f. *cajani* (Padw.) Gord. produces cellulase as well as polygalacturonase in culture and these enzymes may play a role in the disease syndrome.

Further work on the properties and role of the enzymes in the pathogenesis of the fungus is in progress.

Our grateful thanks are due to Dr. R. K. Tandon, Principal, and Dr. Babu Singh, Professor of Botany, Government Agricultural

College, Kanpur, for their keen interest and help during the course of present investigation.

Department of Botany, G. P. SINGH.  
Govt. Agric. College,  
Kanpur and  
Regional Research Centre, A. HUSAIN.  
(Oilseeds and Millets),  
I.C.A.R., Kanpur, August 24, 1961.

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### A TECHNIQUE FOR THE ELIMINATION OF RED ROT SUSCEPTIBLE SUGARCANE SEEDLINGS AT AN EARLY STAGE

SUGARCANE varieties derived from true seed obtained from crosses are tested for red rot resistance at the final stages of selection by the standing cane technique. This is because of dearth of sufficient material for the full-scale test in earlier stages. The drawback of this procedure is the late application of the red rot test after many resistant seedlings have been eliminated in consideration of even small deficiencies in other desirable characteristics. Also, many seedlings selected for other valuable attributes get rejected on account of red rot susceptibility. The need for a method of screening at an early stage has been keenly felt in order to avoid frustration of years of selective effort.

A technique has been evolved which, on the basis of experience during the past few years, appears to be useful in weeding out susceptible clones in the seedling pan stage itself. Seedlings are raised from fluff in the usual manner on a mixture of horse manure, tank silt and sand in seedling pans or flats. When 6 weeks old, they are sprayed with a conidial suspension of *Glomerella tucumanensis*, the red rot pathogen, and immediately placed in a humidity tent of polythene film permitting diffuse light for 48 hours. Incidence of direct sunlight on the tents has to be avoided as it leads to severe sun scald injury. Within 72 hours of inoculation, dark red spots develop on the young shoots. On some seedlings these may be large, irregular in shape and coalescing and may be covered with a profusion of acervuli. On others the spots are spindle-shaped, 1-2 mm. long, with a dark brown margin. On still others, there is

either no reaction or there may be only chlorotic flecks. The seedlings are individually tag-labelled to indicate the category of their reaction, and the leaves are clipped back. Fresh, healthy leaves develop in a few days when the inoculation is repeated to confirm the reaction. The seedlings are again clipped back and the resistant ones, i.e., of the third category, are planted out and grown to sett-plant stage for determining adult reaction by the usual standing cane plug technique.

The results of some of the tests conducted are summarised in Table I wherein the adult reaction of seedlings of all categories of juvenile reaction are shown. It was found that seedlings which showed a resistant reaction gave rise to clones a large proportion of which were resistant also in the adult plant stage, and the rest were moderately resistant with rarely a few susceptible ones. On the other hand, seedlings developing prominent lesions in the juvenile test gave a majority of susceptible to highly susceptible clones with the rest giving a moderately susceptible reaction, but none of them was resistant.

TABLE I  
Adult reaction of clones graded at the seedling stage

Percentage	Juvenile reaction	Adult reaction categories				Total number
		R	MR-MS	S	HS	
Co. 419 × K. 1074 ..	R	53	42	0	0	95
	MR	0	26	3	0	29
	S	0	6	5	9	20
Co. 703 × SES 147A ..	R	90	54	0	0	144
	MR	28	18	4	0	50
	S	0	6	9	9	24
C.P. 36/13 × K. 427 ..	R	139	61	4	0	204
	S	0	19	23	7	49
Co. 281 × SES 90 ..	R	89	17	1	0	107
	S	0	19	55	4	78
Co. 419 × SES 78 ..	R	97	11	2	0	110
	S	0	31	88	6	125

R—Resistant; MR—Moderately Resistant; MS—Moderately Susceptible; S—Susceptible; HS—Highly Susceptible.

In certain juvenile tests, seedlings were inoculated at the age of three weeks, but although they fell into clearly distinguishable categories, many highly susceptible ones were killed outright. But when other seedlings from the same crosses, but 6 weeks of age were simultaneously inoculated, there was no mortality but still the reaction categories were clearly distinct. Such

seedlings could also be pruned for a confirmatory test.

This technique appears to be useful for eliminating from further testing almost all the susceptible seedlings but at present does not appear to be sufficiently sensitive to distinguish between the highly resistant and moderately resistant which can be separated only by the usual inoculation procedures of the sett-plant stage. Since red rot is a serious hazard in North India, only varieties of proven resistance can be recommended for that region, while even in the South, it may not be safe to grow susceptible ones. With the expanded hybridization programme launched recently, this Institute is in a position to produce lakhs of seedlings each year from a multiplicity of crosses and this test is likely to be useful in increasing the chances of selecting resistant varieties which will also be satisfactory in other economic characters. It would also avert the fear of facing disappointment in this respect at very late stages after a great deal of time, money and effort have been spent in selecting, through a number of comparative trials at the Sugarcane Breeding Institute and the State Research Stations concerned, varieties which are superior in other economic characters.

I am grateful to Dr. N. R. Bhat, Director of this Institute, for helpful suggestions in carrying out the work and presenting the results. Shri R. Narasimhan, former Assistant Sugarcane Expert, provided part of the seed for the work, which is gratefully acknowledged.

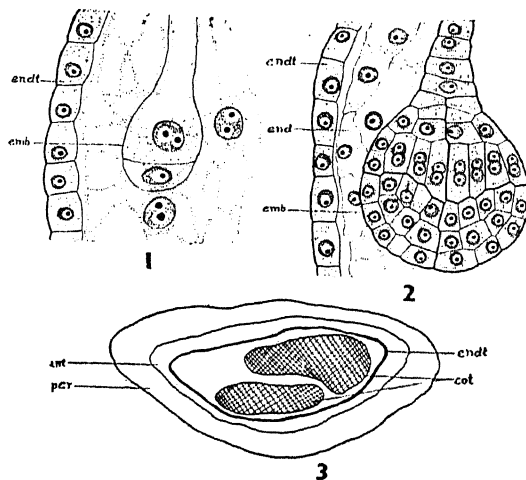
Sugarcane Breeding Institute, K. V. SRINIVASAN.  
Coimbatore-7,  
September 27, 1961.

# A REINVESTIGATION OF THE ENDOSPERM IN *TRIDAX PROCUMBENS* L.

In an earlier note it was demonstrated by the author (Deshpande, 1960) that the layer of cells in *Cæsulia axillaris* simulating an endosperm is not the endosperm proper but it represents the persisting endothelium derived from the inner epidermis of the single massive integument. The author then suggested that the Compositae in which the seeds are reported to have endosperm needs reinvestigation in the light of these findings. One such species is *Tridax procumbens*, in which according to Maheshwari and Roy (1952) the endosperm persists in the form of a layer or two in the seed outside the embryo. The reinvestigation of this species has confirmed that the so-called layer of endosperm is not the endosperm proper but as in *Cæsulia axillaris* it also represents the persisting layer

of endothelium. The development and the ultimate fate of the endosperm and endothelium in *Tridax procumbens* is given below in short.

My observations on the development of endosperm during early stages agree with those of Maheshwari and Roy (1952). But as development proceeds the cells of the endosperm become large and vacuolate (Fig. 2). They are progressively absorbed by the growing embryo leaving no trace of it in the mature seed. The cells of the endothelium on the other hand continue to present healthy appearance. They are rich in cytoplasm and are radially elongated (Fig. 1). This point is also clear from the Fig. 16 of Maheshwari and Roy (1952). During development the direction of the growth changes and they become tangentially elongated when seen in longitudinal section (Fig. 2). In this condition they persist in the seed outside the embryo (Fig. 3) and also show deposits of starch grains in them, serving as an organ of storage.



FIGS. 1-3. *Tridax procumbens* L. Fig. 1. A micropylar part of embryo-sac showing 2-celled embryo, two free endosperm nuclei and endothelium. Fig. 2. The same showing advanced embryo. Note the endosperm with poor cytoplasmic contents and a layer of endothelial cells. Fig. 3. T.s. mature seed showing cotyledons, endothelium, testa and pericarp. cot, cotyledons; end, endosperm; endt, endothelium; int, testa, per, pericarp. Figs. 1-2,  $\times 356$ ; Fig. 3,  $\times 52$ .

On this account probably this persisting layer of endothelium is mistaken for endosperm by various authors. Recently Tiagi and Taimni (1960) reported the presence of endosperm in *Vernonia cinerea*. This requires reinvestigation. Other species of the Compositae where seeds are said to be endospermic, likewise, need reinvestigation.

Thanks are due to Dr. L. B. Kajale, for guidance and helpful criticism.

Department of Botany, P. K. DESHPANDE.  
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### ASCORBIC ACID CONTENT OF WEST INDIAN CHERRY (*MALPHIGIA PUNICIFOLIA* L.)

THE West Indian cherry (*Malphigia puniceifolia*, L.), also known as Puerto Rican cherry, Barbados cherry, Surinam cherry (not to be confused with *Eugenia uniflora* which is also known as Surinam cherry) is one of the richest known sources of natural vitamin C. It is believed to have originated in the Caribbean area. Mustard<sup>4</sup> has estimated the ascorbic acid content of fruits of three species of *Malphigia* including *M. puniceifolia*. Asenjo and Freire de Guzmán<sup>1</sup> have also reported the high ascorbic acid content of the fruits of West Indian cherry which ranged from 1,000 to 3,300 mg. per 100 g. of edible matter.

The present investigation was carried out at the Agricultural College and Research Institute, Coimbatore, with a view to determining the ascorbic acid content of the fruits of two distinct types of West Indian cherry introduced from U.S.A., in 1958, as seedlings. These types varied from each other in the size and colour of leaves, colour of petals, size of fruits, etc. The difference in the fruit size was very conspicuous in that the average weight of a fruit in one type was 6 g. as against 1 g. in the other.

Fully ripe fruits which had attained the ripe red colour were collected separately from these two types and the ascorbic acid content of each was determined by the 2, 6-dichlorophenol indophenol titration method.<sup>2,5</sup> For purposes of comparison, the ascorbic acid content of fruits of guava (*Psidium guajava*, L.) which is also one of the rich sources of natural vitamin C was determined simultaneously. The results of the analyses are given in Table I.

It is apparent from the data given in Table I that the West Indian cherry is far superior to the guava as a potential source of vitamin C. It is richer than even the Indian gooseberry (*Phyllanthus emblica*, L.) which is reported to contain roughly 800 mg. of ascorbic acid per 100 g.<sup>1</sup>

TABLE I

Kind of fruit	Number of samples analysed	pH of the sample	Ascorbic acid content (mg. per 100 g. of edible matter)		
			Range	Average	
<i>M. puniceifolia</i>					
(a) Type I					
(Large fruits)	4	3.6	1,328-1356	1,348	
(b) Type II					
(Small fruits)	4	3.7	1,334-1360	1,357	
<i>Psidium guajava</i>					
var. Bangalore	4	4.4	275- 380	343	

According to Asenjo and Freire de Guzmán,<sup>1</sup> the rose hips (*Rosa* sp.), one of the richest sources of natural ascorbic acid known to date contain 1,700 mg. per 100 g. of edible matter, while their analysis of the West Indian cherry revealed an ascorbic acid content of 1,300 to 3,309 mg. per 100 g. In Moscoso's<sup>3</sup> experiment at the University of Puerto Rico, the vitamin C content of the West Indian cherry ranged between 1,325 and 2,250 mg. per 100 ml. of juice.

It is estimated that the daily nutritional requirement of an adult of 100 mg. of ascorbic acid will be supplied by eight small fruits of type II or one to two large fruits of type I. (The large-fruited type yields fruits weighing on an average six grams, 80% of which forms the edible portion). The fruits can be eaten out of hand or used as a juice, jelly, preserve, syrup, etc. According to Moscoso,<sup>3</sup> an acre of 134 trees will yield about 80 lb. of vitamin C expressed as dehydroascorbic and ascorbic acid. The crop has also been reported to be a good economic source for the production of natural crystalline vitamin C.

The authors are grateful to Dr. S. Krishnamurthi, Dean, Agricultural College and Research Institute, Coimbatore, for his keen interest and encouragement in the study.

V. N. MADHAVA RAO.

J. B. M. MD. ABDUL KHADER.

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**DALECHAMPIA SCANDENS L. VAR.  
CORDOFANA—(HOCHST.) MUELL. ARG.  
A NEW RECORD FOR INDIA**

THE genus *Dalechampia* has been represented by only three species in India. *D. velutina* Wt. and *D. kurzii* have been reported from high altitude regions of Nilgiri Hills and Assam respectively, while *D. indica* has been recorded from the plains of Deccan peninsula, Coromandal and Ceylon and also from some hills in Saurashtra (Kathiawar).

During one of our recent botanical excursions to Vasad, 10 miles N.W. of Baroda, we were able to collect a species of *Dalechampia*, which did not agree in its description with any of the previously recorded species. The same plant was therefore sent to Kew Herbarium for proper determination and has now been identified as *D. scandens*, L. var. *cordofana* (Hochst.) Muell. Arg. Various regional and national floras were referred to in order to check the availability and abundance of this particular plant. It was observed that the plant has not been recorded by any of the previous workers and hence can be considered as a new record for India.

The plant is a slender twiner found on spiny shrubs of *Acacia senegal*, *Zizyphus mauritiana* and *Capparis decidua* along the railway track and also in ravines of river Mahi during the monsoon. The plant is fairly common in the area but has not spread any further.

**Description of Plant.**—*D. scandens* Linn. var. *cordofana* (Hochst.) Muell. Arg. is a slender twiner with stem striate and sparsely hairy. Leaves alternate, stipulate, usually deeply 3-lobed, sometimes upto the middle only; middle lobe is largest (6.4–7 cm.) and the lateral lobes (5.1–5.4 cm.) smaller serrulate, oblique forming a cordate base. Flowers in androgynous head on long peduncles subtended by two yellowish-green conspicuous involucral bracts (3–3.1 cm.) which are trilobed and serrulate. Veins prominently seen; inflorescence head consists of 3 female flowers and a number of male flowers enclosed in a separate involucre with a sticky gland at the back; male flower stalked, calyx 4–6 partite, anthers raised on a central column; female flowers sessile with glandular calyx which persists and enlarges after the formation of fruit; style slender, erect (.8–.9 cm.), stigma 1 mm., flat. Fruit stalked (stalk .9–1 cm.) 3-celled with one seed in each cell; calyx persistent (.9–1.1 cm.) with gland-tipped branches and bristles all over, bristles give an irritating sensation; seeds rounded-oval, creamish-yellow, not hard, 2.5–3 mm.

**Flowering Time** :—July–September.

**Fruiting Time** :—August–October.

**Herbarium specimen Nos.**—CSB 778, 779, 780, 781.



FIGS. 1–6. Fig. 1. Habit. Fig. 2. Inflorescence. Fig. 3. Female flower. Fig. 4. Male involucre. Fig. 5. Male flower. Fig. 6. Fruit with persistent calyx.

Further work is necessary to comment upon the distribution of this plant in India. "The plant is widespread in Tropical Africa, from where possibly it has been introduced in India" (a personal communication from Dr. Taylor).

We are grateful to Dr. G. Taylor, Director, Royal Botanic Garden, Kew, England, for the determination of the plant.

Department of Botany,  
M.S. University of Baroda,  
Baroda, October 10, 1961.

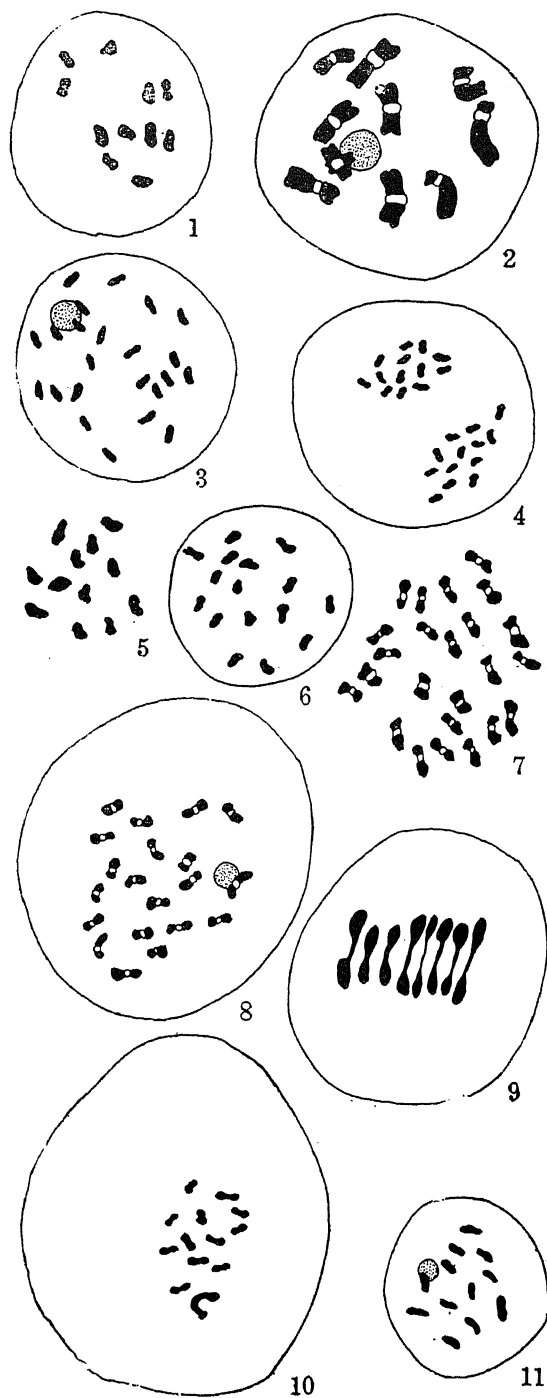
A. R. CHAVAN.  
S. D. SABNIS.  
S. J. BEDI.

**CHROMOSOME NUMBERS OF SOME  
SOUTH INDIAN PLANTS**

CHROMOSOME numbers of 11 taxa spread over 7 families, with a note on the nature of their ploidy are given in the present note. Materials were collected from different localities in Madras State. Flower buds were fixed in Carnoy's fluid (6:3:1) and the young anthers squashed in propino-carmin. Chromosome counts were made from dividing microsporocytes and camera lucida sketches prepared from temporary mounts. The chromosome numbers for all these taxa presented in Table I are reported for the first time.

*Acanthospermum hispidum* with the meiotic chromosome number 11 is a diploid. This appears to be a new basic number for the genus. *A. australe*<sup>1</sup> has a haploid number of 10.





FIGS. 1-11. Chromosome configurations. Fig. 1. *Acanthospermum hispidum*, prometaphase ( $n=11$ ). Fig. 2. *Mesa perrottetiana*, diakinesis ( $n=10$ ). Fig. 3. *Ligustrum decaisnei* var. *beddomei*, diakinesis ( $n=23$ ).

Fig. 4. *Ehretia canarensis*, metaphase II, ( $n=13$ ). Fig. 5. *Plectranthus wightii*, prometaphase ( $n=12$ ). Fig. 6. *Teucrium plectranthoides*, prometaphase ( $n=16$ ). Fig. 7. *Anomum cannaecarpum*, prometaphase ( $n=24$ ). Fig. 8. *Boerhaavia repanda*, diakinesis ( $n=20$ ). Fig. 9. *Banalia thyrsoflora*, early anaphase ( $n=8$ ). Fig. 10. *Apama siliquosa*, prometaphase ( $n=13$ ). Fig. 11. *Lecanthus wightii*, diakinesis ( $n=12$ ). All figures,  $\times 750$ .

*Ligustrum decaisnei* var. *beddomei* has the meiotic chromosome number as 23. All the species of this genus investigated so far are diploids having the same chromosome number.

The three investigated species of *Ehretia*<sup>2</sup> have 8 and 10 as the basic numbers. *Ehretia canarensis* with  $n=13$  is a new basic number for the genus. It is a diploid.

*Plectranthus japonicus*<sup>2</sup> the only other species of the genus investigated has a basic number 6. *Plectranthus wightii* with  $n=12$  is therefore a tetraploid.

TABLE I

Family and taxa	Meiotic chromosome number	Polyploidy	Figure
COMPOSITÆ			
1 <i>Acanthospermum hispidum</i> DC.	11	Diploid	1
MYRSINACEÆ			
*2 <i>Mesa perrottetiana</i> A. DC. ..	10		2
OLEACEÆ			
3 <i>Ligustrum decaisnei</i> Cl. var. <i>beddomei</i> Gamb.	23	Diploid	3
BORAGINACEÆ			
4 <i>Ehretia canarensis</i> Miq. ..	13	do.	4
LABIATÆ			
5 <i>Plectranthus wightii</i> Benth.	12	Tetraploid	5
6 <i>Teucrium plectranthoides</i> Gamb.	16	do.	6
NYCTAGINACEÆ			
7 <i>Boerhaavia repanda</i> Willd.	20	do.	8
AMARANTHACEÆ			
*8 <i>Banalia thyrsoflora</i> Moq. ..	8	Diploid	9
ARISTOLOCHIACEÆ			
*9 <i>Apama siliquosa</i> Lam. ..	13	do.	10
URTICACEÆ			
*10 <i>Lecanthus wightii</i> Wedd. ..	12	do.	11
ZINGIBERACEÆ			
11 <i>Anomum cannaecarpum</i> Benth.	24	Tetraploid	7

\* Chromosome numbers for these genera are reports for the first time.

The basic numbers for the genus *Teucrium*<sup>2</sup> are given as 5, 8 and 13. *Teucrium plectranthoides* with  $n=16$  is a tetraploid in the series with 8 as the basic number.

Thombré<sup>3</sup> reports  $n=58$  in *Boerhaavia diffusa*. He just mentions the number without any illustration. In *Boerhaavia repanda* 20 bivalents

were clearly observed in the microsporocytes. With reference to the other genera of Nyctaginaceae reported, if the basic number is assumed as 10, the present species is a tetraploid.

*Banalia thyrsiflora*  $n = 8$  can be a diploid with the same basic number.

Basic chromosome numbers for Aristolochiaceae<sup>2</sup> are 6, 7 and 12. *Apama siliquosa*  $n = 13$  is a new basic number for the family. It is a diploid. Of the 13 bivalents observed in the microsporocytes, one bivalent is conspicuously long.

The basic number reported for the genus *Amonum*<sup>2</sup> is 12. *Amonum canacarpum* with  $n = 24$  is thus a tetraploid.

I am thankful to Dr. K. Subramanyam, Deputy Chief Botanist, for guidance and Rev. Fr. Santapau, S.J., Chief Botanist, Botanical Survey of India, for encouragement and facilities. Thanks are also due to Mr. A. N. Henry for help in the collection of some materials.

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### THE TAXONOMIC AND GEOGRAPHICAL DISTRIBUTION OF LIPOID IN LEAF IN SACCHARUM AND ALLIED GENERA

The occurrence and significance of fats and lipoids in seeds and leaves of plants for "proper identification of plant groups and their true sequence in evolution" has been reviewed at length by McNair.<sup>1</sup> Recently, surface lipids in plants have been noticed to be useful as characters of taxonomic significance by Purdy and Truter.<sup>2</sup> In *Saccharum* and allied genera, starch in stem<sup>3</sup> and tannin in root-tip<sup>4</sup> have been found to be of use as diagnostic characters for separation of some of the species and genera.

During the course of studies on the botany of *Saccharum* and allied genera, it was noticed through micro-chemical tests that the presence in leaf-blade of the lipoid, Phytosterol, was a variable character among the species of *Saccharum* and the allied genera *Erianthus*, *Sclerostachya* and *Narenga* and could be used as a basis for distinguishing certain of the species. The presence of the lipoid was tested by the chloroform and sulphuric acid method advocated by Johansen.<sup>5</sup> The study was conducted on most of the clones of the four genera

in the World Collection at this Institute totaling 710 and the data are presented in Table I.

TABLE I  
Occurrence of Phytosterol in leaf in *Saccharum*  
and allied genera.

Genus/species	No. of clones examined	No. of clones positive to Phytosterol
<i>Saccharum officinarum</i>	114	nil
<i>S. barberi</i>	58	1
<i>S. sinense</i>	4	nil
<i>S. edule</i>	4	nil
<i>S. robustum</i>	21	2
<i>S. spontaneum</i>	398	154
<i>Erianthus</i> spp.	97	9
<i>Sclerostachya</i> spp.	9	9
<i>Narenga</i> spp.	5	5

Among the species of *Saccharum*, *S. officinarum* was characterised by the total absence of Phytosterol in leaf. The lipoid was absent also in the four forms of *S. sinense* and *S. edule* available at this Institute. In *S. barberi* and *S. robustum*, there were just one or two exceptions. In *S. spontaneum*, however, 40% of the clones proved positive to the test. In this species, there appears to be a general relationship between the occurrence of the lipoid and the geographical location of the clones. Among the collections from South-East Asian countries, only 9% recorded the presence of the lipoid while half the collections from the African continent and the Middle East are characterised by its presence. 40% of the Indian clones have Phytosterol in leaf. On latitude basis, the lipoid is present more commonly in the clones collected from tropical regions in the latitudes 0° to 21° than in those from the subtropical and temperate climatic conditions in latitudes 21° to 39°, the ratio of percentages being 2 : 1. Again clones of the higher polyploid series  $n = 56, 60$  and  $64$  are more commonly positive for this character as compared to the lower series below  $n = 32$ .

The species of *Erianthus*, *E. ravennae*, *E. elephanthinus*, *E. munja*, *E. arundinaceus*, *E. maximus* and *E. fulvus* have no Phytosterol in leaf while *E. Hookerii* and *E. longisetosus* are characterised by its presence. It may be of interest to mention here that these two species, viewed even from morphological characters, are of doubtful inclusion in the genus. The genera *Sclerostachya* and *Narenga* have the lipoid in all the clones and this would appear to add weight to the suggestion of their closer affinity to each other than to *Saccharum* or *Erianthus*.<sup>6</sup> The cultivated noble cane, *Saccharum officinarum* has been suggested as having arisen from

*S. robustum*, *E. maximus* and/or *E. arundinaceus*. The absence of the lipid in all the four species is interesting.

The studies were conducted on about seven months' old crop, the bottommost green leaf being taken as the standard for record of observations. Preliminary indications are that the age of the crop and leaf have no effect on the presence or otherwise of this chemical constituent in the leaf.

Thanks are due to Dr. N. R. Bhat, Director, for interest and encouragement.

Sugarcane Breeding Inst., U. VIJAYALAKSHMI.  
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### STUDIES ON THE GENUS *STAURONEMA* SYD. AND BUTL.

In March 1958, a fungus was collected growing on dead leaves of *Vetiveria zizanioides* Nash. in Varanasi. When seen under a lens, the fungus revealed the presence of pycnidia which are superficial, brown to black, cupulate, rounded and surrounded by long black setae. The pycnidia are on both the surfaces of the leaves. When a pycnidium is pressed under the cover glass on a slide and is seen under the microscope, a mass of spores comes out of it. The conidia are borne on hyaline, rod-shaped conidiophores which are arranged on the inner wall of the pycnidium. They are hyaline and light-yellow when in mass, oblong and straight or curved. Conidia are seen mostly with three appendages, one at each end and one in the middle on the convex side. Variations in number and disposition of appendages on the conidia were also seen: (i) one appendage at each end and one on either side in the middle; (ii) two appendages at one end, one at the other end and one on each side in the middle; (iii) one appendage at each end, two on the same side in the middle; (iv) one appendage at one end and one on either side in the middle; (v) one appendage at each end, two on one side and one on the other side in the middle (Fig. 1).

### CHARACTER OF THE FUNGUS

Pycnidia superficial, amphigenous, scattered, rounded, cupulate, brown to black with long setae, 0.2-0.4 mm. in diameter; setae long, straight or curved, rigid, with bulbous base and tapering end, dark-brown to black at the base, hyaline to light-yellow at the tip, 3-4 septate,  $144-450 \times 5.4-7.9 \mu$ . Conidiophores simple, rod-shaped, hyaline, arranged on the inner wall of the pycnidium, up to  $8 \times 1.8 \mu$ ; conidia hyaline, oblong, straight or curved, generally with three appendages, one at each end and one in the middle on the convex side, appendages straight or curved, occasionally variations in the number and position of appendages on the conidia; latter  $8-12.8 \times 3.2-4 \mu$ , appendages  $4.8-12.8 \mu$  in length.

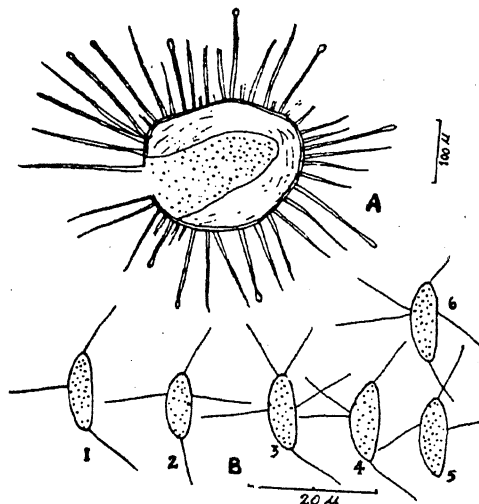


FIG. 1. A, a perithecium; B, conidia with different disposition of appendages on them.

### CULTURAL CHARACTERS

The fungus grows well on potato dextrose agar at 24°C. Colonies white, mycelia submerged and aerial; hyaline  $3.6 \mu$  in diameter and aggregated to form coremia; reverse yellowish. Black dot-like structures are seen in the centre of each colony after two weeks from the inoculation date. The size of pycnidia varies from 1.5-3.5 mm. Setae light-brown to brown at the base, hyaline to light-yellow at the apex, 2-4 septate and measurement as described above. Conidiophores yellowish-white; conidia with the same characters and measurements as described above.

Previously the genus *Stauronema* Syd. and Butl. was considered a sub-genus of *Dinema-sporium* Lev. (Saccardo,<sup>1</sup> 1884) under which two species, viz., *D. cruciferum* Ellis and

*D. platense* Speg. were described. Later on Sydow and Butler<sup>2</sup> (1916) gave a generic rank to this sub-genus and these two species mentioned were named *S. cruciferum* (Ellis) Syd. and Butl. and *S. platense* (Speg.) Syd. Butl. respectively. They also created a new species, i.e., *S. sacchari* Syd. and Butl. on the culms of *Saccharum officinarum* Linn. Assigning the present fungus to any known species of *Stauronema* is ruled out, for the number of appendages, and their disposition on the conidia are not the same as described in these species. It is close to *S. sacchari* but has smaller conidia and does not exactly fit the description of any known species. Further work is in progress and the definite name will be published elsewhere.

The fungus is deposited in the I.M.I., Herb. No. 74894.

Authors are grateful to Prof. R. Misra, for the laboratory facilities, Dr. C. V. Subramanian and the Director, C.M.I., Kew, for their kind suggestions.

Department of Botany, R. Y. ROY.  
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Varanasi-5, August 23, 1961.

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### **HIEROCHLOE ODORATA (L.) BEAUV.— A NEW RECORD FROM HIMALAYAS**

A scientific expedition from the Indian Agricultural Research Institute, New Delhi, surveyed during March-May, 1961, certain regions of Central Nepal Himalayas. The botanical collections made by the authors, during the survey, included a grass species which has now been identified as *Hierochloa odorata* (L.) Beauv. (subfamily Pooideae—tribe Aveneae). This sweet-scented grass was collected from near Puranè village below Muktinath in Central Nepal at an altitude of about 11,000 feet. This species grew in natural pasture and was conspicuous in being one of the very few grasses in flower towards the end of April.

From the literature it appears that this species is distributed from Central and Northern Europe to Manchuria and North America, but there is no record of this species from the Himalayan ranges. Bor (1960) in his treatise on Indian grasses had listed only four species of *Hierochloa* distributed from Khasia hills, Sikkim Himalayas to Lahul Valley at altitudes ranging from 11,000' to 16,000'. Thus the present species, the fifth one, is a new record of its occurrence in the Himalayas.

We are grateful to the Director, Royal Botanic Gardens, Kew, England, for confirming the identification of this species. Shri M. B. Raizada, Head of the Division of Forest Botany, and Shri R. N. Chatterjee, Forest Research Institute, Dehra Dun, also kindly helped us in examining this material.

Division of Botany, H. B. SINGH.  
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### **INHERITANCE OF WHITE FLOWER COLOUR IN PIGEON PEA**

THE inheritance of yellow, orange, purple and red flower colours in *Tur* (*C. cajan*) has been worked out<sup>1,2</sup> but that of the creamy white has not so far been reported. This mutant was first detected by Shri N. B. Kajjari at the Agricultural Research Station, Annigeri (Dharwar District), in the year 1950-51 and its inheritance was studied at the Agricultural Research Station, Niphad (Nasik). It was crossed with a yellow flowered type in 1955-56. The  $F_1$  had yellow flowers. In the  $F_2$  it segregated into yellow and white flowered plants as given in Table I.

TABLE I  
Inheritance of flower colour in *Tur*

	Yellow	White	Total
Observed	35	16	51*
Expected (49 : 15)	39.04	11.96	

$$\chi^2 = 1.7828 \text{ and } P \text{ between } 0.10 \text{ and } 0.20$$

\* Note: There was shedding of flower-buds due to the selfing of plants and as a result large population could not be obtained in  $F_2$  and  $F_3$  generations.

It will be seen from Table I that the observed and expected frequencies give a good fit on 49 : 15 basis. It is a trihybrid ratio in which two duplicate factors  $W_1$  and  $W_2$  produce creamy white flower. This colour is inhibited by  $I^v$  and renders the flower yellow.

These  $F_2$  results were confirmed in  $F_3$ . 19 families were raised, of which eight were derived from white flowered individuals and eleven from yellow flowered types. Four families from white and two from yellow bred true while the others gave different ratios as shown in Table II.

Table II gives the segregation of the  $F_3$  families derived both from white and yellow flowered  $F_2$  individuals. Four have segregated into 3 white : 1 yellow; three into 15 yellow; 1 white, five have given 3 yellow : 1 white and

TABLE II  
Segregation of flower colour in  $F_2$

S. No.	Observed	Expected	$X^2$	P between
$F_2$ = white ; $F_3$ = 3 wh. : 1 yel.				
1	43 : 11	40.50 : 13.50	0.478	0.50 & 0.30
2	34 : 20	40.50 : 13.50	4.173	0.05 & 0.02
3	36 : 18	40.50 : 13.50	2.000	0.20 & 0.10
4	32 : 19	38.25 : 12.75	4.085	0.05 & 0.02
$F_2$ = Yellow ; $F_3$ = 15 yel. : 1 wh.				
5	10 : 2	11.25 : 0.75	2.222	0.20 & 0.10
6	17 : 3	18.75 : 1.25	2.613	0.20 & 0.10
7	46 : 7	49.69 : 3.31	4.379	0.05 & 0.02
$F_3$ = 3 yel. : 1 wh.				
8	41 : 15	42.00 : 14.00	0.095	0.50 & 0.70
9	46 : 12	43.50 : 14.50	0.575	0.50 & 0.30
10	40 : 11	38.25 : 12.75	0.320	0.70 & 0.50
11	39 : 11	37.50 : 12.50	0.240	0.70 & 0.50
12	41 : 12	39.75 : 13.25	0.157	0.70 & 0.50
$F_3$ = 49 yel. : 15 wh.				
13	31 : 3	33.69 : 10.31	0.721	0.50 & 0.30

one 49 yellow : 15 white. These results thus confirm the 49 : 15 ratio observed in  $F_2$ . The inhibitory factor  $I'$  has mutated and given rise to the creamy white type. This new type will be useful in maintaining purity of the strain as it has a marker gene.

The authors are grateful to Shri N. B. Kajjari for having kindly supplied the seeds of the white flowered mutant.

Department of Agriculture,  
Maharashtra State,  
Poona-5, November 4, 1960.

J. A. PATIL.  
R. D'CRUZ.

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### CLUSTER BEAN (GUAR)—A NEW LOCAL LESION HOST FOR DOLICHOS ENATION MOSAIC VIRUS

DOLICHOS enation mosaic virus (DEM V) produces systemic infection in *Dolichos lablab* L., systemic necrosis in *Phaseolus vulgaris* and primary lesions with secondary systemic mottling in *Nicotiana tabacum*.<sup>1,2</sup> However, no suitable local lesion host for DEM V has so far been located. Cluster bean (guar) (*Cyamopsis tetragonoloba* L. = *C. psoraloides*) is reported to be a local lesion host for potato virus S,<sup>3,4</sup> potato virus M,<sup>4</sup> rose mosaic virus<sup>5</sup> and catjang mosaic virus.<sup>6</sup> We, therefore, included cluster bean vars., 'Large Green' and 'Pusa Sadablar', with other hosts for DEM V infection and have succeeded in producing local necrotic lesions on this host.

Potted cluster bean plants grown in the green house were inoculated on cotyledonary leaves with DEM V-sap from *Dolichos lablab* leaves on

the 7th day after sowing. It was noticed that while no lesions appeared on the controls, numerous diffused spots were observable at the end of 24 hours on the DEM V-inoculated leaves. At the end of 48 hours, these spots developed into grey or black, small countable necrotic lesions, which turned brown and also showed a tendency to coalesce later (Fig. 1-A). Further,

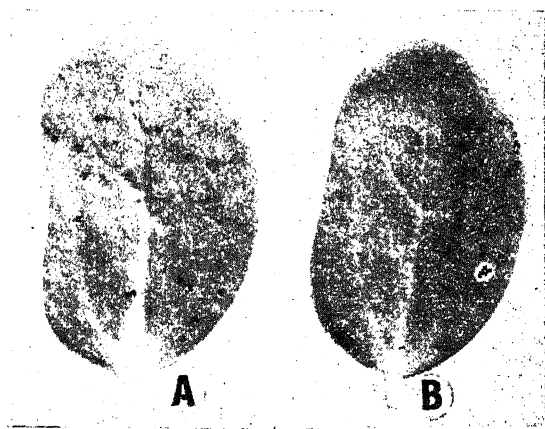


FIG. 1. Necrotic local lesions on cotyledonary leaves of cluster bean. A—Full leaf inoculated with DEM V-sap. B—Left half (control). Right half (inoculated with DEM V-sap).

when half-leaves were inoculated keeping the other halves as control, only the inoculated halves produced lesions (Fig. 1-B). Well-defined lesions were produced on subsequent leaves also (tried up to 5th leaf stage), when individually inoculated with DEM V-infected *D. lablab* sap. Similar lesions were produced (within 24-48 hours) when the cotyledonary leaves were detached and floated in water soon after inoculation. Parallel observations have shown that the same infective sap, which produced local necrotic lesions on cluster bean leaves, produced systemic infection in *D. lablab*.

Back inoculation tests with sap from infected cluster bean leaves to healthy *D. lablab* plants were found to induce characteristic symptoms of DEM V infection. However, it was interesting that the sap from infected cluster bean leaves, when inoculated to healthy cluster bean leaves, did not produce local lesions. This aspect is being further investigated.

The fact that cluster beans can be raised under laboratory conditions very easily and that the lesions appear within the course of 24-48 hours, makes it a very convenient assay plant for a rapid screening of DEM V. When water in which roots of DEM V-infected *D. lablab* plants were immersed, was rubbed to cluster

TABLE II  
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The authors are grateful to Shri N. B. Kajjari for having kindly supplied the seeds of the white flowered mutant.

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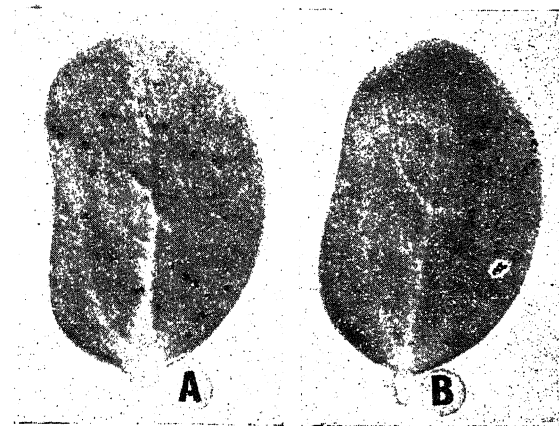


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The fact that cluster beans can be raised under laboratory conditions very easily and that the lesions appear within the course of 24-48 hours, makes it a very convenient assay plant for a rapid screening of DEM V. When water in which roots of DEM V-infected *D. lablab* plants were immersed, was rubbed to cluster

bean leaves, a few lesions appeared,<sup>7</sup> showing thereby the sensitivity of the test.

I am deeply indebted to Prof. T. S. Sadasivan and to Dr. V. T. John for suggestions.

University Botany Lab., K. RAJAGOPALAN.  
Madras-5, December 16, 1961.

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### NOTES ON AIR-BORNE *TETRAPLOA* SPORES

As early as 1873 Cunningham<sup>1</sup> in the course of his studies on the air-spores of the Presidency and the Alipore jails in Calcutta recorded the occurrence of spores of the fungus *Tetraploa* in the air. Subsequently, apart from a brief report<sup>5</sup> on an undetermined species of *Tetraploa* collected on *Bothriochloa* in Kusmhi forest near Gorakhpur, there seems to be no other record on the occurrence of this fungus in India. In studies concerned with the air-spores of the paddy fields in the Andhra Pradesh, we have observed the regular occurrence of spores belonging to this genus in the air. Notes on the spore characters, their diurnal and seasonal periodicities based on the catches on slides exposed in the Hirst spore trap<sup>3</sup> with some comments on the biological advantages of having a tetra-radiate form of spore are presented here.

According to Ellis<sup>2</sup> there are only five species of *Tetraploa* and microscopic examination of the spores caught on our slides exposed in the spore trap (Fig. 1) indicated the occurrence of spores of two species [*T. aristata* Berk. and Br. (type a) and *T. ellisii* Cooke.] which are slightly smaller in dimensions than those described by Ellis.<sup>2</sup> The structural details and the measurements for the two types based on an examination of fifty spores selected at random from the traces on the slides exposed on different days are given in Table I. The smaller dimensions of these air-borne spores are probably due to the loss of turgidity and consequent shrinkage after they get into the air.

An analysis of the *Tetraploa* catches on thirty-four slides taken at random from the exposures at Visakhapatnam in 1960 showed that out of

one hundred and four spores examined, eighty-eight belonged to *T. aristata* (type a), twelve

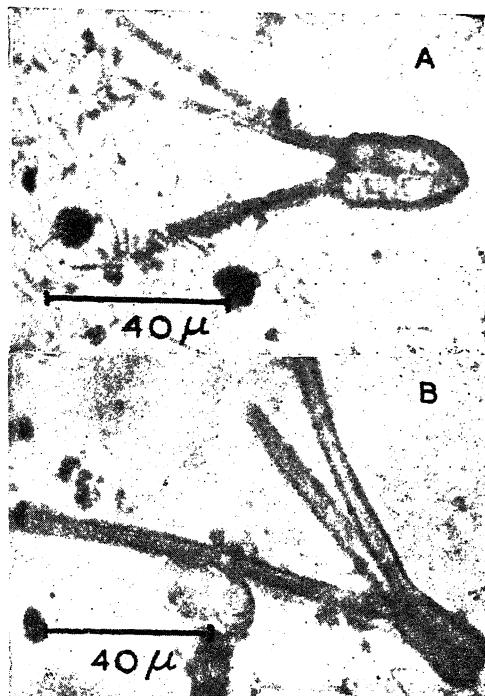


FIG. 1. Photomicrographs illustrating the two types of air-borne *Tetraploa* spores at Visakhapatnam. (A) *T. aristata* type caught on 22 October 1960 at 06:00 hrs. (B) *T. ellisii* type caught on 31 July 1960 at 10:00 hrs.

TABLE I

Structural details and measurements of the air-borne spores of *Tetraploa aristata* (type a) and *T. ellisii* types caught on slides exposed in the Hirst spore trap

	Spore type			
	<i>T. aristata</i> (type a)		<i>T. ellisii</i>	
	Variation $\mu$	Average $\mu$	Variation $\mu$	Average $\mu$
Body of the spore:				
Length ..	16.5-34.5	26.0	16.0-32.0	26.2
Diameter at base	8.0-12.0	10.1	9.0-14.0	11.7
Maximum diameter	10.5-27.0	15.3	13.0-21.0	16.3
Number of cells in each column	3-5	..	3-5	..
Setose appendages:				
Length ..	16.5-94.5	38.2	43.5-102.0	81.3
Diameter at base	3.0-6.0	4.3	4.0-8.0	5.8
Diameter at apex	1.5-3.0	2.3	1.5-3.0	2.5
Number of septa	1-6	..	4-12	..
Number of spores examined	40		10	

to *T. ellisii* and the identification of four to species level was not possible because of their unsuitable orientation on the traces. An examination of the figures given by Cunningham<sup>1</sup> in Pl. V (Figs. 3 and 4), Pl. IX (Fig. 2) and Pl. VI (Fig. 2) (depicting the catches on 22 May and

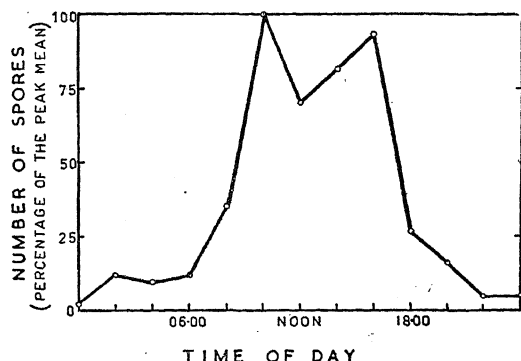


FIG. 2. Mean diurnal periodicity curve expressed as the percentage of the peak arithmetic mean concentration.

7 July 1872 in the Presidency jail and on 15 May 1872 in the Alipore jail, respectively) revealed that out of the five spores illustrated, four belonged to *T. aristata* (type a). Data available<sup>6</sup> for Pentapadu (West Godavary Dist., A.P.) area also showed the abundance of *T. aristata* (type a). All these observations indicate that *T. aristata* is more common in India.

A marked diurnal periodicity was observed for the spores of *Tetraploa* on many days when they occurred in the air. They were practically absent in the air during the night time and even during daytime maximum concentrations recurred between 10:00 and 16:00 hrs. The diurnal periodicity observed for the total of the two types of *Tetraploa* spores at Visakhapatnam in 1960 is shown in Fig. 2. The average concentration observed at their peak hour (10:00 hrs.) was 7/m.<sup>3</sup> and the highest number recorded in 1960 was 100/m.<sup>3</sup> on 31 July at 10:00 hrs.

Spores belonging to the genus *Tetraploa* were caught on one hundred and eleven days chiefly in the months of April, July, October and December in 1960 at Visakhapatnam. The comparatively high numbers recorded on some days in these months are associated with some agricultural operations (like the puddling and preparation of plots for transplantation of rice seedlings and subsequent flooding of these plots) carried on in the fields and the occurrence of rainfall. Ellis<sup>2</sup> found that when the infected parts of the host are covered with a thin film

of water a number of spores break off and float to the surface and that they move down with the flow of water. He suggested that flood water plays some part in spore liberation and dispersal. Our observations at Visakhapatnam and the data available<sup>6</sup> from the Pentapadu area indicate that flooding influences the number of spores getting into the air to some extent.

The production of this type of tetra-radiate reproductive unit is common among several aquatic hyphomycetes and some marine algae like *Sphacelaria*. The radiate form of spore produced by these organisms may have some biological advantages in the aquatic environment. As observed by Ellis<sup>2</sup> the chances of dispersal are increased because the spore is kept floating for several hours or on the other hand as suggested by Ingold<sup>4</sup> this radiate form with the appendages helps in anchorage by getting the spore entangled in a suitable substratum. The massive size of the spore allows the accumulation of more reserve food and because of its peculiar shape it may not be easily devoured by small aquatic animals. To examine some of these possibilities Webster<sup>7</sup> conducted experiments using different spores of aquatic hyphomycetes and found that the trapping efficiency of the tetra-radiate spore is considerably higher than that of other spore forms included in this study.

With our present knowledge it is not possible to describe the mechanism by which the tetra-radiate spores (having a form so well adapted to the aquatic habitat) become air-borne. The presence of long setose appendages projecting into the air from the spores floating on the flat water surface suggest that 'blow-off' is possible.

Our thanks are due to the late Shri G. Jagannadha Raju and Shri G. Ramachandra Raju for permission to conduct air sampling in their paddy field and to Prof. J. Venkateswarlu, Head of the Botany Department, for his interest in this work.

Botany Department,  
Andhra University,  
Waltair, October 7, 1961.

T. SREERAMULU.  
A. RAMALINGAM.

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## REVIEWS

### Measure, Lebesgue Integrals, and Hilbert Space.

By A. N. Kolmogorov and S. V. Fomin.  
(Academic Press, New York and London),  
1961. Pp. xii + 143. Price \$ 4.00.

This book constitutes the second volume of the programme of the course of lectures on "Elements of the Theory of Functions and Functional Analysis" delivered by Prof. Kolmogorov at the Moscow State University. It is significant that the contents of the volume before us should be based on the course of lectures repeatedly given by him in the Mechanics-Mathematics Faculty, for, in spite of their abstract nature, these topics play a prominent part in statistics and many branches of applied mathematics. The combination of the theory of Lebesgue measure and Lebesgue integral with the theory of Hilbert space may not, at first sight, appear quite appropriate, but the setting up on the basis of the first two topics, a space  $L_2$  of the so-called square-integrable functions which is isomorphic with Hilbert space provides a natural connecting bridge.

An innovation in the development of the Lebesgue measure theory is the free use of Borel sets which possess the property that the sum, difference or product of two such sets is again a Borel set, so that a class of these sets forms a system of double composition. This fact is utilised to build up an elegant theory of measure by introducing quite early the abstract notions of rings, semirings, and algebras. A very interesting general result derived is that the system of all Lebesgue measurable sets is a Borel algebra with unit  $E$ . Another innovation is the use of plane sets from the very beginning, thereby affording an intuitive understanding of abstract concepts. For those used to Lebesgue measure on the line  $R_1$ , it comes as a surprise, on reading the first chapter, to realise how much more well adopted the plane  $R_2$  is for the purpose of aiding the intuition. In particular, the construction on p. 14 of the example of a non-measurable set on the circle is very elegant in contrast to what appear to be trivial examples of such sets constructed in  $R_1$ . An unusual topic made specially intuitive by the use of plane sets is that of Jordan measure.

The use of algebraic methods is continued in the treatment of the Lebesgue integral also to make precise the notion of Borel measurable

functions used in the development. Further preliminaries relate to the  $\mu$ -measurability of a real function which is dealt with on lines closely paralleling the treatment of de la Vallée Poussin, and the introduction of a special type of what are known as simple functions. Based on all these, the Lebesgue integral is given a rigorous treatment, and one finds here a wealth of basic properties of this integral, including the important Tchebichev inequality, Fatou's theorem, and Radon's theorem. Nowhere, however, do we find a reference to the Lebesgue-Stieltjes integral except for a passing reference on p. 17 to Lebesgue-Stieltjes measures.

The last two chapters relate to Hilbert space  $H$ , and the first of these adopts an intuitive approach by introducing earlier the space  $L_2$  of square integrable functions isomorphic to  $H$ , mentioned above. The treatment of the Lebesgue integral in the previous chapters is fully utilised to develop  $L_2$  rigorously, and derive a series of very interesting properties of the same including the possibility of the introduction of orthogonal systems of functions, and the process of orthogonalisation. This topic which is of great interest in applications is treated comprehensively, culminating in the derivation of the fundamental Riesz-Fischer Theorem. Also considered in this chapter is the space  $l_2$ , dealt with by Prof. Kolmogorov in the first volume of the programme devoted to metric and normal spaces, viz., the space whose elements are sequences of numbers  $x = (x_1, x_2, \dots)$  satisfying the relation  $\sum_{n=1}^{\infty} x_n^2 < \infty$ , and

also isomorphic to  $H$ . The Riesz-Fischer theorem is used to establish directly the isomorphism of the spaces  $l_2$  and  $L_2$ , and it is pointed out that this isomorphism is related closely to certain problems in quantum mechanics, for e.g., from the purely mathematical point of view, the difference between the "matrix" and "wave" mechanics is reduced to the fact that in constructing the mathematical apparatus corresponding to each, Heisenberg used  $l_2$ , while Schrodinger used  $L_2$ .

The last chapter, specifically devoted to the abstract Hilbert space  $H$ , defines this space by five axioms, and shows that both  $l_2$  and  $L_2$  satisfy these axioms. The notions of sub-spaces of  $H$ , the direct sum of Hilbert spaces, the linear and bilinear functionals in  $H$  the latter, when

symmetric, leading to adjoint operators and the completely continuous self-adjoint operators in  $H$  leading to orthonormal systems, eigen-values of operators, and the reduction of matrices to diagonal form have all been treated briefly, but clearly, and are of much value in applications. The last topic dealt with is the application of  $H$  to solve integral equations with symmetrical kernel, and the related questions of finding eigen-values and eigen-functions of the corresponding integral operators, on the classical Hilbert-Courant methodology.

The volume before us constitutes an excellent introduction to the three topics treated in it, from the points of view of both pure mathematics and theoretical physics.

B. S. MADHAVARAO.

**The New Age in Physics.** By H. S. W. Massey. (Elek Books Ltd., 14, Great James Street, London, W.C. 1), 1960. Pp. 342. Price 42 sh.

The extraordinary developments that have taken place in recent years in technology and measurements have completely changed the phase of Physics. It is possible now to count individual atomic particles and to make visible their tracks in gases and liquids. The physicist nowadays can study the properties of certain unusual kinds of matter, which are available to him in amounts so small that the chemist processing a millionth of a gram of a substance for analysis would seem, by comparison, to be dealing with matter in bulk. Frequencies can be measured to one part in ten million, and time intervals as small as one thousand millionth of a second can be made significant in measurement and control. Linear accelerators two miles long can produce energy tens of billions of electron volts. Whereas three decades ago the average man of science was satisfied that there existed only, say, six fundamental particles, namely, a heavy mass (protonic) and a light mass (electronic) each of which can be associated with a plus, a minus, or a zero charge, now he is confounded with more than thirty particles which have been physically detected, and yet no one believes that the end has yet been reached. Half this number are antimatter! The oddest particle is the 'ghost' particle the neutron, whose most significant property is that it has no observable properties at all! And yet we know quite a lot about it and this knowledge has led to new ideas and new basic laws about the universe.

This phenomenal progress in physical science has naturally made great impact on everyday life, and the average intelligent man who has

studied science in his school or college is naturally inquisitive to understand these developments. It is for this class of readers (and of course, not to speak of the professional scientists in other disciplines), that this book *The New Age in Physics*, by Professor Massey, is intended.

Professor Massey has set on himself the difficult task of explaining the latest techniques and results in physical research in non-technical terms, and without in the least sacrificing scientific accuracy he has admirably succeeded in this. The contents of the book can broadly be divided into three sections. The first three chapters are concerned with atoms, electrons and atomic structure, followed by two chapters on relativity and quantum mechanics. The next section is concerned with nuclear physics, fundamental particles, and behaviour of matter at high energies, and this occupies four chapters. The last section of three chapters takes the reader from atomic scale phenomena to large-scale phenomena and deal with radioastronomy, upper atmosphere, and artificial satellites and space probes.

The book provides excellent reading to the nonspecialists and the generally educated public. The diagrams and photographs have been carefully chosen to drive home the explanations in the text. The get-up of the book is excellent, and the large type used in printing will make the reading of the book a pleasure.

A. S. G.

**Books on Quantum Mechanics:** *Quantum Mechanics.* By Eugen Merzbacher. (John Wiley and Sons, New York-16; India: Asia Publishing House, Nicol Road, Bombay-1), 1961. Pp. xii + 544. Price \$12.00; *Quantum Mechanics.* By J. L. Powell and B. Crasemann, 1961. Pp. x + 495. Price \$9.75; *Introduction to Quantum Mechanics.* By R. H. Dicke and J. P. Wittke, 1961. Pp. xi + 369. Price \$8.75. (Addison-Wesley Pub. Co., Inc., Reading, Massachusetts, U.S.A.)

While it is true that quantum mechanics has not yet provided a consistent description of elementary particles and interacting fields, there is no doubt that its importance in applications to atoms, molecules, nuclei, radiation theories, solid state physics, etc., has shown enormous progress. The subject which two decades ago was confined to a few chapters only in books on theoretical physics, now has grown so vast that separate volumes are devoted to it.

Eugen Merzbacher develops the subject in three stages, firstly ordinary wave mechanics with solutions of simple problems, secondly the

matrix form of quantum mechanics, and lastly the more abstract Dirac formulation.

In the *Introduction to Quantum Mechanics*, the authors Dicke and Wittke by limiting the scope of the text to the non-relative theory are enabled to develop the subject in a logical way first, showing how the basic concepts of classical mechanics must be altered to explain many atomic-scale phenomena, second, laying the groundwork for the more formal approach to quantum mechanics and wave mechanics, indicating their use in well-known problems, and lastly extending the scope to many other problems which can be effectively handled by this mathematical tool. The last chapter deals with quantum statistical mechanics extending the application to problems of modern physics.

The third book under review by Powell and Crasemann is written in a more advanced level. After a few introductory chapters along historical lines, the subject proper is introduced through a discussion of linear operations, eigen functions and commutation relations. Then there is the development of the algebra of linear vector spaces, methods of matrix mechanics, perturbation theory and the theory of radiation transitions. The last chapter gives a brief treatment of identical particles.

The three books can be recommended as suitable text-books on the subject for the Honours and Post-graduate students of Indian Universities.

**Introduction to Transients.** By D. K. McCleery. (Chapman and Hall, 37, Essex Street, London, W.C. 2), 1961. Pp. xi + 232. Price 42 sh.

Transient phenomena, governed by the exponential law, are of fundamental importance in electric circuit theory. Solution of problems beyond the single RC or RL circuits is a feat of memory to an average student of engineering. The standard method of solving them that has come into vogue is by the use of the Laplace transformation and contour integral methods. Rightly, this gives a rigorous treatment to which no mathematician will take exception. But to an "engineering man" who may be excused for possessing but an ordinary knowledge of calculus, it becomes too difficult a tool to be used with confidence.

The author believes that a simpler approach is possible, namely, the operational calculus of Heaviside's, to solve nearly all cases of linear circuits. The treatment is simple and logical. The book will be found suitable to first year electrical engineering students and to those who

take the Diploma Technical Course. The chapters include Transients in thermionic valves, Extension theorem and Applications to cables, Surges on transmission lines, The superposition principle and the Laplace transform, and Response of circuits to alternating stimuli. It is unfortunate that the author did not live to see the book in print.

**Long Range Ballistic Missiles.** By Eric Burgess. (Chapman and Hall, 37, Essex St., London, W.C. 2), 1961. Pp. xii + 255. Price 35 sh.

The book gives a complete and readable survey of the ballistic missile field; its history, basic theory, applications as space boosters, defence, submarine launched missiles and test facilities. To collect the material for the book the author, who is well-known for his previous books on space technology, rocketry, etc., travelled many thousands of miles across the United States visiting the missile ranges test centres, air bases, missile plants, etc. The book is well-illustrated and will appeal to the general reader who is interested in the subject.

**The Methods of Plane Projective Geometry Based on the Use of General Homogeneous Co-ordinates.** By E. A. Maxwell. (Cambridge University Press, London, N.W. 1), 1960. Pp. xix + 230. Price 13 sh. 6 d.

This book was first published in 1946 and has already gone through six reprints, which speaks for its popularity and demand amongst those for whom it has been intended. In this book the author has given an excellent introduction to the methods of projective geometry, based on the use of homogeneous co-ordinates. It is not merely a catalogue of theorems but an appreciation of the methods, and as such lays the foundations for extensions in the subject as for example, study of the geometry of figures in three dimensions or in higher spaces. A valuable feature of the book is the large number of carefully selected and graded problems for solution.

**Boundary and Eigenvalue Problems in Mathematical Physics.** By Hans Sagan. (John Wiley and Sons, Inc., 440, Park Avenue South, New York-16, N.Y.; India: Asia Publishing House, Bombay-1), 1961. Pp. xviii + 381. Price \$9.50.

Graduate and Honours students of Physics of Indian Universities will find much useful material in this text-book. Written from the author's experience gained as a teacher and

based on his lectures to science and engineering students the book deals with a variety of topics.

The first three chapters deal with some basic concepts such as Hamilton's principle and the theory of the first variation, Partial differential equations applied to heat conduction, vibrating strings and membranes, and Bernoulli's separation method for the solution of linear homogeneous partial differential equations. These concepts lend unity to the subject-matter developed in the remaining chapters of the book on Self-adjoint boundary value problems, characterization of eigenvalues by a variational principle, and the non-homogeneous boundary value problem.

Graded problems which follow almost every section will help the student in understanding the new techniques developed in the section and gaining confidence in their use. A good knowledge of vector analysis, convergence and differential equations is expected on the part of the reader.

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**Partial Differential Equations of Mathematical Physics.** By Harry Bateman. (Cambridge University Press, London, N.W. 1), 1961. Pp. xxii + 522. Price 27 sh. 6 d.

This unique reference book by Professor Bateman needs no new introduction or re-reviewing. Suffice it to say that it has been popular with the students of mathematical physics for nearly 30 years, i.e., ever since its first publication in 1932. As is well known, in this book, the analysis has been developed chiefly with the aim of obtaining exact analytical expressions for the solution of the boundary problems of mathematical physics.

Cambridge University Press has put all students and teachers of mathematical physics under a debt of gratitude in bringing out this classical reference work in cheap paper cover edition so that every one of them may own a copy.

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**Chemical Instrumentation.** By Howard A. Strobel. (Addison-Wesley Publishing Co. Inc., Reading, Massachusetts, U.S.A.), 1960. Pp. 653. Price \$ 9.75.

The fundamental purpose of all instrumentation is to seek information about the nature of a physical property and to use this information to regulate the process in such a manner that the measured quantity is maintained at the desired value. In the control of chemical processes, the chemical nature of the substance is normally indicated by a related physical property. The regulation is then achieved by con-

trolling other parameters, such as temperature, flow, pressure or pH. In recent years, automatic control based on on-line chemical analysis has been applied with remarkable success in the process industry and it has become increasingly necessary for the chemical engineer and the control engineer to have a basic appreciation of the methods employed.

The book under review provides a systematic treatment of the methods of measurement and quantitative analysis of chemical composition. Based on a two-semester course to advanced undergraduates in chemistry, the text has a research orientation and there is a strong undercurrent of physical and chemical theory and of instrument design.

The success of the book is due, in a large measure, to the fact that the author presents physical theory without recourse to mathematics. The emphasis throughout has been on the need to develop a functional understanding of the methods and instruments used.

The Chapters are organized into four groups. The first (pages 1-36) defines the basic requirements of an instrument for indicating, recording and controlling and demonstrates how the static observations could be searched, methodically, to define their level of confidence. The second (pages 37-266) discusses "Opticometric" methods, i.e., techniques based on the interaction of light and other electromagnetic radiation on matter. This part considers emission spectroscopy, absorption and scatter photometry, refractometry and polarimetry. The third section (pages 267-599) deals with "Electrometric" methods based on the measurement of electrical and electrochemical properties, such as conductivity, e.m.f., electrolysis and radioactivity. The final section (pages 600-645) describes twenty-four laboratory experiments, well organised to give the student a working familiarity with the handling of representative instruments.

The bibliography is exhaustive and well classified.

PREM J. BHATT.

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**Radio for Examinations.** By H. I. F. Peel. (Cleaver-Hume Press Ltd., London), 1961. Pp. vii + 364. Price 55 sh.

*Radio for Examinations* is a book written with the object of helping students appearing for certain professional examinations in England such as those of the City and Guilds, I.E.E., and the Brit. I.R.E.

The contents of the book cover the familiar examination topics such as tuned circuits,

amplifiers, oscillators, transmission lines, aeri-als, direction finding, receivers, television principles, loud-speakers, microphones, etc. The author's plan is to give a brief refresher survey of the important expressions relating to the subject-matter of each chapter and work out typical numerical problems from previous examinations. Only a reader who has previously studied the standard texts will be able to benefit from this book as the book is not intended as a substitute for the text-books. The book will be particularly useful to private students who have not had the normal training in answering examinations in a college. The rather high price of the book does not appear to be consistent with the object of making it a useful aid to students.

B. S. RAMAKRISHNA.

*Comparative Biochemistry, Vol. II—Free Energy and Biological Function.* Edited by M. Florkin and H. S. Mason. (Academic Press, New York; India: Asia Publishing House, Bombay-1), 1961. Pp. xi + 685. Price \$ 20.00.

The second volume of the comprehensive treatise on comparative biochemistry deals with free energy and its relation to biological function. The opening contribution by Atkinson and Morton is concerned with free energy and the biosynthesis of phosphate esters which are invariably associated with energy utilization and synthesis of new cell material fundamental to life. The thermodynamic aspects of phosphoryl and phosphate transfer reactions, the mechanism of enzymatic synthesis of phosphates by transfer reactions and by reversal of phosphorolysis and pyrophosphorolysis and the importance of phosphoryl transfer sequences in metabolism are described in great detail. The utilization of free energy for the biosynthesis of saccharides is taken up in the next article by Leloir, Cardini and Cabib who discuss the interconversion and the synthesis of monosaccharides from carbon dioxide and as a result of reversal of glycolysis, free energy changes in the formation of glycosidic bonds and the biosynthesis of di-, oligo-, and polysaccharides.

Diversity in the nature and structure of proteins is the basis of metabolic and morphological changes and is a manifestation of differences in the genetic material. Chantrenne gives a lucid account of the comparative biochemistry of free energy utilization for the biosynthesis of peptides and proteins and draws attention to the striking similarity of the fundamental mechanism of protein synthesis. Cohen and Brown contribute an article on ammonia metabolism and urea bio-

synthesis in which several reactions involved in ammonia production and utilization are considered and the energetics of various systems discussed. The enzymatic steps in the synthesis of urea are treated extensively and emphasis is laid on the fundamental importance of carbamyl phosphate in all living cells because of its role in the synthesis of arginine and pyrimidines.

The mechanisms of muscular contraction and other forms of movements in motile structures in various organisms are considered in the next two chapters wherein the central role of actomyosin complex in muscular contraction and the importance of adenosine-triphosphate and alterations in the form of protein structures in most of the phenomena of biomotility are emphasized. Considerable space is allotted to topics like cellular permeability and the utilization of free energy accumulated in cells to achieve the proper distribution of ions between a cell and its environment and to maintain the structural mosaic responsible for the various permeability characters of living membranes. Four chapters are devoted to a detailed consideration of the phenomenon of active transport, the maintenance of the balance of water and other diffusible components and the mechanisms of osmoregulation, nerve conduction and electrical discharge. The importance of the proper distribution of ions between a nerve and its surroundings for the generation of bioelectric potential and for the subsequent use of this electric current through morphological adaptations to transmit messages between distant points of an organism, is stressed. In the last chapter on Bioluminescence, Newton Harvey gives a most satisfactory survey of a field which is rapidly growing in biochemical significance and interest. The general distribution of luminescence in the living world, the nature of the luciferin-luciferase reactions and the essential chemistry of light production in well-known luminescent systems like the firefly and the ostracod crustacean, *Cypridina*, are all clearly explained.

The volume under review can be highly recommended as a valuable acquisition for all those interested in the study of comparative biochemistry.

P. S. SARMA.

*Spores II.* Edited by H. Orin Halvorson. (Burgess Publishing Company, Minneapolis 15, Minn.), 1961. Pp. ix + 296. Price \$ 5.00.

The bacterial spore is unique for its dormancy, and resistance to heat and injurious chemicals. Study of bacterial spores is important both from

public health and industrial points of view as they are instrumental in the spread of some diseases and the spoilage of foods during storage. Further, some of the bacterial spore formers produce antibiotic substances which are finding use in animal feeds, and to a limited extent in internal medicine. Spores of *Bacillus papillæ* have been successfully used in the control of the Japanese beetle and it is possible that other spore formers may prove useful in the microbial control of noxious insects.

Notwithstanding the above compelling reasons, the study of bacterial spores has been neglected by experimental biologists. The reasons for this neglect are not far to seek. A dormant system is apparently not as interesting or exciting as a dynamic system. Also these are not as easily amenable to study as a dynamic system. So for long the challenge of the bacterial spore has gone unaccepted.

The study of bacterial spores has been greatly stimulated by three findings, namely the observation by Hills that spores germinate rapidly in a chemically defined medium consisting of a mixture of amino-acids and nucleotides, the discovery by Halvorson and associates of active heat resistant enzymes and the discovery by Powell that spores contain dipicolinic acid which is absent in the homologous vegetative cells. These observations have been greatly extended in the past few years and significant advances have been made in understanding the mechanisms of germination, sporulation and dormancy. The role of dipicolinic in the resistance of the bacterial spore to heat is becoming increasingly intelligible and bacterial spores deficient in dipicolinic acid and as sensitive to heat as the homologous vegetative cells but at the same time dormant have been produced. These developments augur well for further rapid advances in this interesting field.

*Spores II* contains papers and discussions on several aspects of spore physiology and cytology presented by recognized specialists at the Second Allertan Spore Conference attended by nearly 80 investigators from the United States, Canada and other countries. All the papers contain unpublished data and the book will be of interest and importance to microbiologists concerned with food preservation, public health and spore research. K. G. GOLLAKOTA.

**Cytology and Evolution.** By E. N. Willmer. (Academic Press, New York), 1960. Pp. 430. Price \$ 10.00.

This is a novel and unorthodox approach to the problem of evolution of cells and tissues. It

has been customary to view organic evolution in the context of recent advances in cytology and genetics. But attempts at extension of these analyses to explain the organization and integration of cells into a well ordered system of organs and tissues during embryogeny has met with little success. The author views the problem of cell and tissue evolution from his experience in the study of tissue cultures. Starting with mechanoblasts (fibroblasts) and amœoblasts the possible evolution of the vertebrate cell families are indicated in a genealogical tree (p. 226).

"The internal organization of a cell is unbelievably complex on the molecular and even sub-microscopic level. The results, therefore, obtained by making extracts of cells or tissues is not unlike trying to find out the plan of the practical course in biological chemistry at a university by applying the most modern and efficient demolition machinery (cf. the Waring blender) to the biochemical laboratory, with all its contained and systematically arranged chemicals, and then analysing the fluid that subsequently runs down the drains." (p. 406).

How far the suspicions voiced recently that even normal tissues on continued sub-culture have a tendency to become malignant affect these speculations on cell evolution is not indicated. Some of the photographs reproduced lack clarity. M. K. S.

#### The Glycolysis and Respiration of Tumours.

By Alan C. Aisenberg. (Academic Press, New York and London), 1961. Pp. 223. Price \$ 8.00.

Since the initial observations of Warburg in 1923 on the abnormally high rate of anaerobic glycolysis of the tumours, the problem of damaged respiratory balance in relation to ætiology of cancer is constantly under study. These studies evoked two controversial schools of thought. One belongs to the group of Potter and his colleagues and the other of Weinhouse and his co-workers. The author of the present book has succeeded in presenting the whole problem of energy metabolism of tumours in a balanced and critical manner. The author has maintained an unbroken chain of thought in the book by laying together the considerable information on the subject, in a continuous narration.

The first part of the book has been devoted to the different aspects of glycolysis of normal and malignant cells *in vivo* and *in vitro*. The author has presented the massive data on the carbohydrate and intermediary metabolism of normal and malignant cells in a tabular form.

He has discussed at length (1) The hexose mono-phosphate shunt operating in tumour tissue, (2) role of cofactors in oxidation, (3) specific oxidative components of the tumours and tumour mitochondria. According to the author, the role of mitochondria in damaged respiration of malignant cells is still to be explored.

In the latter part of the book Warburg's theory of carcinogenesis, the Pasteur effect and the Crabtree effect have been set forth expanded. Lastly, he has tried to co-ordinate the abnormally high rate of glycolysis with the synthetic processes of tumour cells.

The book with its extensive bibliography relates the different aspects of energy metabolism in lucid style and has brought together contradictory experimental work under one cover. It will also be a valuable reference book for workers engaged in metabolic studies on cancer cells. It could therefore be stated that a monograph on this subject is a welcome addition to this important field of study.

V. R. KHANOLKAR.

**Progress in Cryogenics**, Vol. 3. Edited by K. Mendelssohn. (Heywood and Company Ltd., Tower House, Southampton Street, London, W.C. 2), 1961. Pp. vii + 173. Price 45 sh.

Historically low temperature research is linked up with liquefaction of gases. The phenomenon of superconductivity and superfluidity added importance to the subject. Now, however, low temperature studies, or Cryogenics as it is called, have expanded into such new fields as the operation of computers, and microwave amplifiers, the separation and storage of free radicals, the production of high magnetic fields for thermonuclear reactors, etc. Cryogenics is now closely related not only with fundamental problems of physics but has increasing applications in industry and technology. With the increase in the number of laboratories, both academic and industrial, engaged in low temperature studies literature on the subject is also getting scattered in the various journals and research bulletins. Workers in this field who would like to keep abreast of developments will welcome this new series "Progress in Cryogenics" published under the editorship of Prof. K. Mendelssohn.

Volume 3 contains critical reviews and up-to-date information on the following subjects:

- (1) "Helium Liquefiers", by A. J. Croft;
- (2) "Low Temperature Heat Exchangers", by A. G. Lenfestey;
- (3) "Novel Refrigeration Cycles and Devices", by W. E. Gifford;

- (4) "Cryogenic Rocket Propellants", by I. E. Smith;
- (5) "Paramagnetic Substances for Nuclear Orientation", by R. P. Hudson;
- (6) "Dynamic Nuclear Orientation", by C. D. Jeffries.

#### Books Received

**The Surface Chemistry of Solids.** By S. J. Gregg. (Chapman and Hall, 37, Essex Street, London, W.C. 2), 1961. Pp. xvii + 393. Price 60 sh.

**The Nature of Life.** By C. H. Waddington. (George Allen and Unwin, Ruskin House, 40, Museum Street, London, W.C. 1), 1961. Pp. 131. Price 18 sh.

**Catalogue of Scientific Periodicals in Calcutta Libraries.** Compiled by K. Bhattacharyya. (Asiatic Society, 1, Park Street, Calcutta-16), 1961. Pp. vii + 263.

**Reports on Progress in Physics** (Vol. XXIV). By A. C. Stickland. (The Institute of Physics and Physical Chemistry, London, S.W. 1), 1961. Pp. 424.

**Electron Microscopy—A Hand Book for Biologist.** By E. H. Mercer and M. S. C. Birbeck (Blackwell Scientific Publications, Oxford), 1961. Pp. vi + 76. Price 9 sh. 6 d.

**Techniques for Electron Microscopy.** Edited by Desmond Kay. (Blackwell Scientific Publications, Oxford), 1961. Pp. xvii + 331. Price £ 3.3 sh.

**The Atom—Friend or Foe?** By Charles Noel Martin. (George G. Harrap and Co., 182, High Holborn, London, W.C. 1), 1962. Pp. 236. Price 25 sh.

**Biochemical Society Symposia No. 21—The Structure and Biosynthesis of Macromolecules.** (Cambridge University Press, 200, Euston Road, London, N.W. 1), 1962. Pp. 131. Price 20 sh. (paper). 30 sh. (cloth).

**Introduction to Theoretical Physical Chemistry.** By Sidney Golden. (Addison-Wesley Pub. Co., Reading, Massachusetts), 1961. Pp. xi + 307. Price Rs. 10.75.

**Advances in Inorganic Chemistry and Radiochemistry** (Vol. III). By H. J. Emeleus and A. G. Sharpe. (Academic Press Inc., New York; India: Asia Publishing House, Bombay-1), 1961. Pp. ix + 463. Price \$ 12.50.

**British Medical Bulletin—Genetics of Micro-Organisms**, Vol. XVIII, No. 1, January 1962. (The Medical Department, The British Council, 65, Davies Street, London, W. 1), 1962. Pp. 88. Price 20 sh.

**Elementary Zoology.** By M. A. Moghe. (Macmillan and Co., 6, Patullo Road, Madras-2), 1962. Pp. viii + 311. Price Rs. 6.50.

## SCIENCE NOTES AND NEWS

## Award of Research Degrees

Andhra University has awarded the D.Sc. Degree in Chemistry to Shri G. S. R. Subba Rao for his thesis entitled "Chemistry of *Terminalia* Species".

Annamalai University has awarded the Ph.D. Degree in Chemistry to Shri K. Ganapathy for his thesis entitled "A study of the expansion of the valence shell of sulphur by ultra-violet spectral and dipole moment measurements".

Osmania University has awarded the Ph.D. Degree in Botany to Shri Raghuveer Rao Padbidri for his thesis entitled "Nutrition Studies of *Trichoconis padwickii*, Gangully" (Part I) and "Additions to Fungal-Flora of Hyderabad" (Part II).

The M. S. University of Baroda has awarded the Ph.D. Degree in Chemistry to Messrs. Manubhai Vrijlal Shah and M. G. Patel for their theses entitled "Studies in Chromosomes and Flavones" and "Studies in Coumarins" respectively; and the Ph.D. Degree in Zoology to Shri S. D. Pishawikar for his thesis entitled "A Study of the Phosphates, Phosphatases and Certain Inorganic Ions in the Pectoralis Muscle of Some Birds with Special Reference to that of the Pigeon."

## Conference on Low Energy Nuclear Physics

The Institute of Physics and the Physical Society announces that it is sponsoring a conference on "Low Energy Nuclear Physics" to be held at the Atomic Energy Research Establishment, Harwell, on 10, 11 and 12 September, 1962.

It is proposed to devote sessions to the following: The nuclear interactions of slow and fast neutrons; Nuclear reactions induced by charged particles and  $\gamma$ -rays; Nucleon-nucleon interactions; Nuclear structure and nuclear models.

Further details of the Symposium may be obtained from the Administration Assistant, The Institute of Physics and the Physical Society, 47, Belgrave Square, London, S.W. 1.

## Indian Institute of Metals

The Indian Institute of Metals has awarded The Kamani Gold Medal for 1960 to Dr. T. R. Anantharaman of the Department of Metallurgy, Indian Institute of Science, Bangalore, for his paper "Structural Irregularities in Mechanically Deformed Cobalt".

## Evidence for the Gravitational Red-Shift on the Sun

J. F. Blamont and F. Roddier report a measurement of the profile of the solar strontium resonance line  $^1P_1-^1S_0$ , 4607.3 Å, by a method permitting high resolution [*Phys. Rev. Letters*, 1961, 7 (12), 437]. Observation of this profile on the limb of the sun as well as the centre of the disk permits an unambiguous separation of wave-length shifts caused by mass motion on the sun and the gravitational red shift. The shift attributable to the relativistic effect is found to be very close to the theoretical value.

The axis of the line profile from the limb of the sun is shifted to the longer wave-length side from the axis of the line profile from the centre of the disk. The observed shift is  $12 \times 10^{-3}$  Å. The theoretical value of the gravitational red-shift is  $9.76 \times 10^{-3}$  Å. If we add to this the pressure red-shift of the Lindholm effect, which is  $2.4 \times 10^{-3}$  Å for the considered line with  $T = 5700^\circ \text{K}$  and  $10^{17}$  hydrogen atoms per c.c., the total shift is  $12.10 \times 10^{-3}$  Å, which is exactly the experimental value.

The success of this observation of the red-shift is due to the fact that in the experiment atoms are used as a clock both on the sun and the earth. This removes errors made in wave-length calibration.

 $\beta$ -Ray Method for Density of Wood

A new method developed by the Forest Products Research Laboratory, U.K., for the density determination of wood may be of value in the study of other materials which, like wood, are not uniform in structure. Determinations are made by passing the wood specimen across the path of a very narrow, collimated beam of beta particles and counting the number which get through the wood. The absorbing power is related to the density provided the thickness of the wood specimens is kept constant. Over a range of density there is a simple logarithmic relationship, so that by incorporating a logarithmic ratemeter in the system and a sector drive to move the specimen, the density variation across individual growth rings can be plotted automatically on a chart recorder. The set-up can be adjusted to suit the range of density recorded.



### Organic Molecules for Stimulated Light Emission (*Laser Action*)

Investigations on solid-state systems displaying stimulated emission have concentrated on inorganic ions, notably  $\text{Cr}^{+++}$  ion in ruby. Recently Morantz *et al.* have reported that the phenomenon of stimulated emission by optical pumping and energy transfer occurs also in organic systems. The phenomenon depends on the spin-forbidden triplet-singlet transition which is available particularly in organic systems.

The system comprised the aromatic molecular species in a rigid matrix at  $77^\circ \text{K}$  between parallel reflecting plates. This was pumped by an intense flash of light. It was observed that at a critical intensity of light the usual phosphorescence decay was replaced by bursts of light and the level of the subsequent luminescence was reduced below "normal" phosphorescence level.

The observation is of significance from the following considerations: The vast range of aromatic molecules available will yield optical frequencies in the visible, in part of the ultraviolet, and in the infra-red regions; control of these frequencies is possible by small changes in molecular structure. The large variety of molecular parameters should enable a more detailed consideration of the nature of the forces at work during stimulated emission, and energy transfer studies may be carried out under stimulated emission conditions.—[*Phys. Rev. Letters*, 1962, 8 (1), 24.]

### Second Order Raman Spectra in Some Tetrachlorides

It is known that there exists a parallel between the magnitude of the first polarizability derivative with respect to the natural co-ordinate and the character of the chemical bond formed by the vibrating atoms. Information on this permitting one to refine the theoretical presentations, and also some aspects of the light scattering phenomenon itself, can be obtained by a comparative measurement of the intensity of the overtones and the fundamental vibrations. Generally speaking, both mechanical and electro-optical anharmonicity acting simultaneously are required for the appearance of higher order spectra in Raman scattering.

In a communication [*Optics and Spectroscopy*, 1961, 11 (3), 184] Bobovich reports the results of investigations on the first and second order Raman Spectra of  $\text{CCl}_4$ ,  $\text{SiCl}_4$ ,  $\text{GeCl}_4$  and  $\text{TiCl}_4$ . Based on analysis of the data obtained conclusions are drawn regarding the magnitude

and the sign of the ratio of the second and first polarizability derivatives with respect to the normal co-ordinate. The question of the influence of the character of the chemical bond in the molecules investigated on the intensity of their spectra is discussed, an interpretation of the anomalous behaviour of  $\text{CCl}_4$  is given.

### Ultrasonic Echo-Ranging to Measure the Motion of the Human Heart

At a recent acoustical instrumentation symposium held in Bethesda, Maryland, a method of using pulsed ultrasonic to measure the motion of the walls and septa of the human heart was reported. The technique depends on the reflections of a transmitted pulse from interfaces between different tissues and is applicable to most soft tissues except the lung. There is no damage to tissue because very low powered devices are used.

Recordings of the position of cardiac structures were made over a distance range from 2 to 13 cm. Motion was recorded to a linearity of about 1%; frequency response was uniform to nearly 1000 cps. System time delays, which are important for synchronization with other records, were small and accurately calculable.—[*Jour. Acous. Soc. Amer.* 1961, 33 (12) 1808].

### New Light on the Second Layer in the Ocean Floor

A new method of seismic shooting—the technique of mapping strata in the earth's crust by means of echoes from explosions—has provided a strong clue to the nature of what is known as the "second layer" in the ocean floor. The layer which lies between the sediments at the bottom of the sea and the "basement" rocks of the earth's crust and which has been thought to consist of hardened sediments, now appears to be composed of igneous rocks. These rocks may well represent the original solid surface of the earth.

The Lamont Geological Laboratory of the Columbia University has developed a method, based on an automatic explosion-echo recording instrument, of charting layers below the deep ocean floor in such details as were never attempted before. Recently the method was used on board the research vessel *Vema* to obtain sub-bottom charts along 30,000 miles of track in the Atlantic, the Antarctic and the Pacific Oceans.

When the records were examined, they revealed everywhere a layer of relatively hard rock above the basement rocks. This "second layer" was previously known chiefly in shallow

seas and only occasionally detected in the deep ocean. Surprisingly the second layer was not smooth, as it should have been if it had been formed from sediment, but was quite rough; this suggests that the layer is composed of igneous rocks. Moreover, no signs of disturbance were found in overlying sediments, showing that the layer could not have been intruded after the sediments started collecting. It must have been there before the sediments began to collect.—(Sc. Amer., 1962, 206, 64).

### On the Origin of Natural Diamonds

Laboratory experiments on the preparation of synthetic diamonds have provided sufficient data of a reliable nature and it should be possible to put forward tentative hypotheses about the origin of natural diamonds.

Natural diamonds can be classified into two groups, namely, meteoritic and terrestrial. Although relatively few meteorites (Canyon Diablo, Gualpura and Novolbe) have so far been found to contain diamonds and the total weight of all diamonds extracted from meteorites up to now is only about 10 g. (50 carats), these diamonds resemble each other far more than they resemble any kind of terrestrial diamond. Meteoritic diamonds are found as friable black lumps composed of many tiny diamond crystals, each perhaps 0.01 mm. or less in average diameter. The crystal size of terrestrial diamonds on the other hand is usually considerably larger; it is rarely below 0.02 mm. even in carbonado, and is often from 5 to 10 mm.

Experiments on the preparation of synthetic diamonds have enabled broad conclusions to be drawn relating the various conditions of formation (such as pressure, temperature, chemical environment and time) and the kind of diamond produced. They are: (1) No diamond forms unless the pressure is high enough for diamond to be stable at the particular temperature employed. With the catalyst systems now known the minimum pressure is about 45000 bars. (2) Diamond forms from non-diamond carbon in the presence of a molten metal (or molten metal-carbon mixture) which acts as a catalyst for the transformation by mechanisms that mainly resemble the solution and deposition of carbon. The best catalytic metals are Cr, Mn,

Fe, Co, Ni, Ru, Rh, Pd, Os, Ir, Pt. (3) The habit of a diamond crystal depends principally upon the pressure and temperature at the instant of its formation. (4) The higher the temperature of formation for a given system, the more colourless are the resulting diamonds. At the very lowest temperatures so far found (1200° C), the diamonds are usually black. (5) At a given temperature, the more the pressure exceeds that necessary for equilibrium the greater the rate of nucleation and growth of diamond crystals, and the smaller and more imperfect they are. (6) At pressures below about 50,000 bars the cube habit predominates, at higher pressures the octahedral habit is more common.

The above laboratory tests indicate that the most likely conditions of formation of meteoritic diamonds may have been high pressure (above 55,000 bars) and low temperature (about 1,200° C.) with graphite as the source of carbon and iron or an iron alloy as the catalyst. In this way black polycrystalline diamond lumps could be formed.

On the other hand, terrestrial diamonds for the most part could have been formed at somewhat high temperatures (1,600° C.) and pressures 60,000 bars and higher by processes of pressure increase and/or temperature decrease. When the processes occurred *rapidly*, polycrystalline diamond could have formed. When they occurred *slowly* the larger more perfect-crystals could have formed.—(Astrophys Jour., 1961, 134, 995.)

### Upper Atmospheric Density from Observations on Satellite Orbits

The air drag acting on a satellite near its perigee point causes its orbit to contract, and by measuring the rate of contraction the air density near perigee can be deduced. The results obtained by this method have been very consistent and satisfactory, and have shown that the density tends to fluctuate in response to solar activity, the density being greatest when the Sun is most active. At heights above 300 km. there is also a large variation between day and night, the maximum daytime density exceeding the minimum night-time density by factors of 2½ at 400 km. and 8 at 600 km.

# UPPER AIR CHANGES OVER INDIA AND NEIGHBOURHOOD ASSOCIATED WITH THE SOUTH-WEST MONSOON

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AS is well known, by far the most important feature of Indian weather is the south-west monsoon on which the agricultural economy of the country is so vitally dependent. The monsoon "bursts" over the Malabar coast by about the end of May, establishes itself over the whole country by the end of June and holds sway over the country for the next three months. The monsoon begins to weaken and retreat by the end of September. By the middle of October the south-west monsoon withdraws from the whole of North India and the central parts of the country; the pattern of circulation associated with the south-west monsoon undergoes a reversal and gives place to the north-east monsoon which brings rain to the eastern parts of

2. In an interesting paper published in the Rossby Memorial Volume, Yeh Tu-Cheng, Dao Shih-Yen and Li Mei-Ts'un (1959) have drawn attention to the abrupt changes in the circulation over the northern hemisphere which they have noticed in June and October. Their conclusions are based on the study of the zonal winds from 850 to 200 mb. across five meridional sections—45° E, 90° E, 120° E, 165° E and 80° W—from the equator to latitude 50° N. In June they find a sudden northward shift of the westerlies and easterlies which heralds the establishment of the typical summer circulation. In October there is a sudden southward swing of the westerlies and easterlies which marks the beginning of the establishment of the typical winter circulation. The onset of the summer circulation is accompanied by the outburst of the south-west monsoon in India; the onset of the winter circulation signals the retreat of the monsoon. The Indian summer monsoon is thus seen to be an integral part of the general circulation of the northern hemisphere. The Chinese authors have put forth the interesting suggestion that so far as the upper atmospheric circulation is concerned there are only two natural seasons, namely a summer of short duration and a winter of considerably longer duration. The transitional periods are of brief duration and the transitions from summer to winter circulation and *vice versa* occur rather abruptly.

3. In connection with some work that we have recently undertaken we examined the seasonal variation of the mean monthly contour heights of standard isobaric surfaces at four radiosonde/rawin stations across India which lie approximately along a meridian. The stations considered are:—

		Latitude	Longitude
Trivandrum	..	08° 30' N	76° 59' E
Madras	..	13° 00' N	80° 11' E
Nagpur	..	21° 07' N	79° 07' E
New Delhi	..	28° 35' N	77° 12' E

For each of the standard isobaric levels 850, 700, 500, 300, 200, 150 and 100 mb. the mean monthly values of contour heights based on 1200Z radiosonde ascents for the five-year period 1956-60 were plotted on the same grid for the stations in question. The diagram thus obtained is shown in Fig. 3. In this diagram

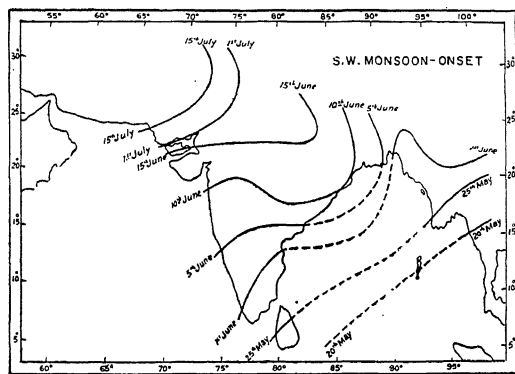


FIG. 1

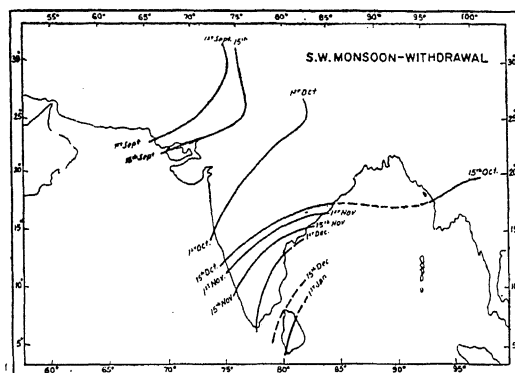


FIG. 2

south peninsular India during the months October to December. Figures 1 and 2 show the normal dates of onset and withdrawal of the monsoon over different parts of the country.

the mean monthly upper winds based on rawin ascents for each of the four stations are also depicted for the different levels. It should be mentioned that the wind data are based on averages for periods which are not quite homogeneous with the period for which the radio-sonde data of contour heights relate.

other three curves reaching a maximum in November. The pressure gradient at the 850 mb. level ( $\sim 1.5$  km.) between Trivandrum-Madras-Nagpur gets reversed by about the end of April, Trivandrum pressure becoming higher than that of Madras and Nagpur. As

SEASONAL VARIATION OF CONTOUR HEIGHTS AND WINDS  
AT STANDARD ISOBARIC LEVELS ACROSS INDIA

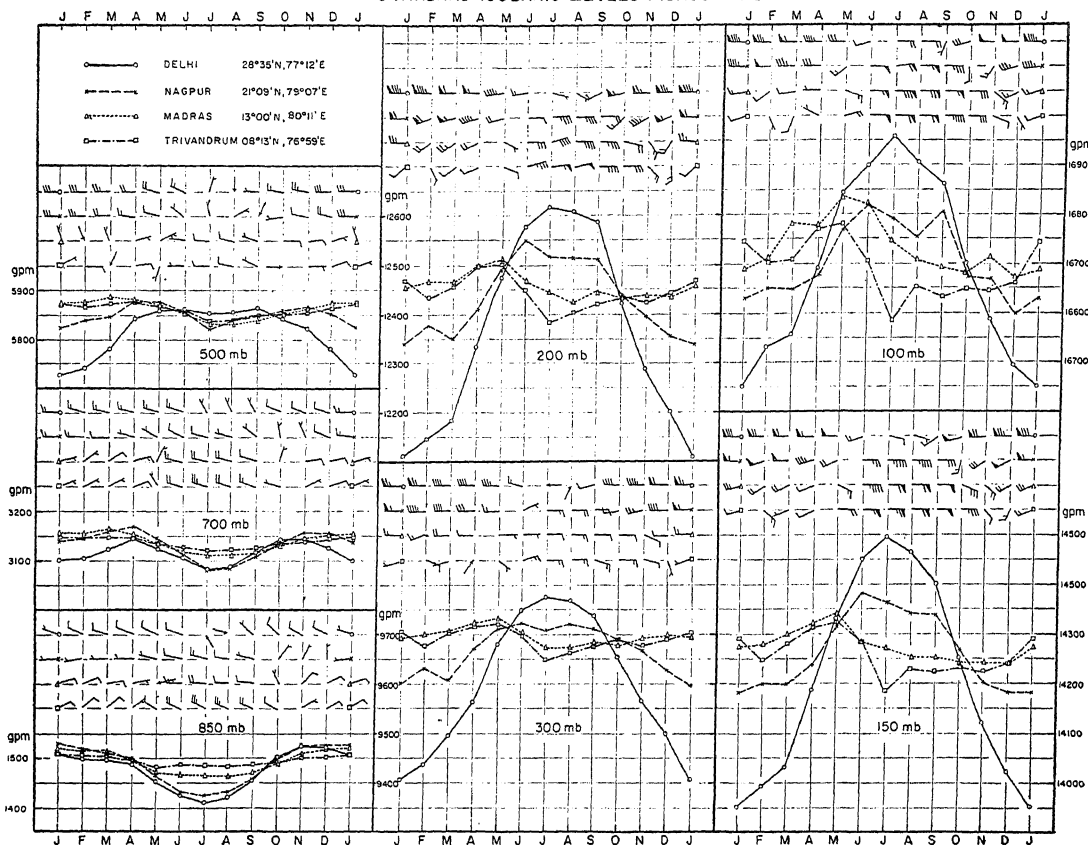


FIG. 3

4. An inspection of Fig. 3 brings out several interesting points some of which are the following:—

- (i) The contour height of the 850 mb. surface at Delhi remains lower than that at the other three stations during all the months from January to October. From about the middle of April a steep and progressive fall sets in over Delhi and Nagpur reaching a minimum value in July after which the trend is again reversed. By about the end of September the Delhi curve overtakes the

a consequence of this the ENE/NE winds at Trivandrum are replaced by WNW/NW winds in May which strengthen considerably with the steepening of the pressure gradient accompanying the onset of the monsoon.

- (ii) At the 700 mb. level ( $\sim 3$  km.) the annual variation of pressure over Delhi and Nagpur shows two maxima, one in April and the other in November. The minimum at both places occurs in July. At this level the reversal of pressure gradient between Madras and

Trivandrum occurs in May and again in October. The pressure gradient between Delhi and Nagpur at 3 km. level is very feeble in the monsoon months.

(iii) At the 500 mb. ( $\sim 6$  km.) the Delhi curve overtakes the other three curves at the beginning of June. From June to September the pressure over Delhi remains higher than that over the three southern stations. By the end of September the Delhi curve again crosses the other three curves in the opposite direction. The July minimum in the Delhi curve is now very flat compared with the two lower levels. It is noteworthy that at the 500 mb. level the lowest value of contour height occurs over Nagpur in July. Pressure gradients across the country and hence the wind circulation are feeble at this level in the monsoon months.

(iv) The contour height curves and winds for the upper tropospheric levels bring out the remarkable changes that occur at these levels in association with the onset and retreat of the south-west monsoon. The Delhi curve for all the four levels are nearly similar with a steep maximum in July. At 100 mb. level the Delhi curve overtakes the curves for the other stations by the *first week of May*. From May to July there is a progressive fall of pressure over Trivandrum at 100 mb. level ( $\sim 16.5$  km.) while the pressure over Delhi is rising. The gradient across the country is thus progressively built up reaching a maximum by the middle of July which is the peak of the monsoon season. The easterlies over Madras and Nagpur at 100 mb. level reach their maximum strength in July.

(v) At 150 mb. level ( $\sim 14$  km.) the Delhi curve overtakes the curves for the other three stations by the *second week of May* resulting in the reversal of the pressure gradient across the country at this level. At 200 mb. level ( $\sim 12$  km.) the Delhi curve overtakes the other curves in the *third week of May* while at 300 mb. level ( $\sim 9$  km.) the crossing takes place in the *last week of May*. As already mentioned, at 500 mb. level the Delhi curve overtakes the other curves in the *first week of June*.

(vi) Thus starting from the 100 mb. level towards the end of April and working progressively downwards, the pressure gradients at all the upper tropospheric levels across the country get reversed by the end of May. The reversal of the pressure gradients in the upper troposphere brings about a complete reversal in the circulation and signals the burst of the south-west monsoon. The reversal of circulation in the upper troposphere is very well brought out by the winds plotted on the 200, 150 and 100 mb. contour diagrams.

(vii) The contour diagrams for all the levels show that the peak of monsoon activity is reached by the middle of July.

(viii) From the end of September a reverse sequence of events takes place. The contour height curve for Delhi crosses the other three curves by the end of September or the beginning of October at 500 and 300 mb. by the middle of October at 200 and 150 mb. and by the end of October at 100 mb. The monsoon or summer circulation in the upper troposphere completely changes over to the winter circulation by the end of October.

(ix) Thus May and October are the transitional months during which the winter type of circulation changes over to summer type and *vice versa*. The transition from the winter to summer circulation builds upwards in the lower troposphere and downwards in the upper troposphere. The sequence of events appears to proceed in the opposite direction in the upper troposphere for the change-over of the summer to the winter circulation.

(x) It is interesting to note that preceding the onset of the monsoon the curves for the upper tropospheric levels of 300, 200 and 150 mb. in Fig. 3 cross nearly at a common time epoch which varies systematically from level to level. This would account for the rather abrupt nature of the transition associated with the onset of the monsoon popularly known as the "burst" of the monsoon. The reverse transition is similar but not identical in its abruptness to the onset.

5. In an interesting paper entitled "Seasonal Changes in Upper-Air Conditions in the Mediterranean—Middle East Area" Sutcliffe and

Bannon (1954) have drawn attention to an association between the upper air-changes near the tropopause over the Middle East and the onset of the Indian summer monsoon. Table I gives the dates of onset of monsoon on the Malabar coast in the years 1948 to 1953 with associated upper tropospheric changes observed over Aden (Lat. 12° 49' N, Long. 45° 02' E), Bahrein (Lat. 26° 16' N, Long. 50° 37' E) and Habbaniya (Lat. 33° 22' N, Long. 43° 34' E).

TABLE I

	1948	1949	1950	1951	1952	1953
1 First appearance of easterly winds over Aden at 200 mb. ..	..	May 18	May 19	May 25	May 12	May 22
2 End of Polar type tropopause over Habbaniya ..	June 9	May 27	May 22	May 26	June 1	June 11
3 Onset of SW monsoon on Malabar coast ..	June 10	May 23	May 27	May 31	May 28	June 7
4 First appearance of easterlies over Bahrein at 200 mb. ..	June 15	June 13	June 10	June 13	June 8	June 20

It will be seen that the appearance of the easterlies over Aden precedes the onset of the monsoon by one to two weeks. An inspection of Fig. 3 shows that in respect of the South Indian stations Trivandrum and Madras also, the easterlies get established in the upper troposphere before the onset of the monsoon, the mean winds for the month of May being easterly at all the upper tropospheric levels.

6. Examination of contour heights of standard isobaric levels in respect of Aden and Bahrein based on averages for the period 1948-50 shows that preceding the onset of the Indian southwest monsoon the reversal of pressure gradient between Aden and Bahrein takes place in the upper tropospheric levels at nearly the same

epochs at which the reversal of the gradient between Madras and Delhi takes place over the Indian region.

7. Our study shows that there is great similarity between the upper tropospheric changes over the Middle-east stations and over the Indian region preceding the onset of the Indian summer monsoon. As Sutcliffe and Bannon have pointed out, a careful study of these changes may have prediction value. We are making a detailed study of the upper air

conditions over India and neighbourhood for the seven years 1955-61. Preliminary examination shows that the early onset of the monsoon in 1956, the late onset and early withdrawal of the monsoon in 1957 and the good monsoon activity in 1961 are all reflected in the contour diagrams for the upper tropospheric levels. Fuller details of our work will be published in the *Indian Journal of Meteorology and Geophysics*.

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## ULTRASONIC ATOMIZATION OF LIQUIDS

WHEN a beam of ultrasonic sound of sufficient intensity is passed through a liquid and directed at an air interface, atomization of the liquid occurs. Liquid particles are ejected from the surface into the surrounding air, and under proper conditions very fine dense fogs may be produced. Unlike pneumatic atomization, the ultrasonic atomization has this advantage that the fog particle size and fog density can be independently controlled.

It has been suggested that capillary surface waves play a role in the atomization mechanism. This has been found to be the case according to R. J. Lang who reports the results of an experimental study on ultrasonic atomization

[*Jour. Acoust. Soc. Amer.*, 1962, 34 (1), 6]. He finds that a definite relationship exists between the capillary wavelength at a given frequency and the size of the particles produced. Frequency range from 10 to 800 kc was used in the experiment and surface disturbances were studied by photographic method. Special methods were employed to measure the particle size.

It was found that uniform crossed patterns of capillary waves were formed on the liquid surface when atomization occurred. The diameter of the particles produced was found to be a constant fraction, 0.34, of the capillary wave-length.

CHEMICAL COMPONENTS OF THE LARVAE OF *LACCIFER LACCA*

R. MADHAV, T. R. SESHADRI AND G. B. V. SUBRAMANIAN

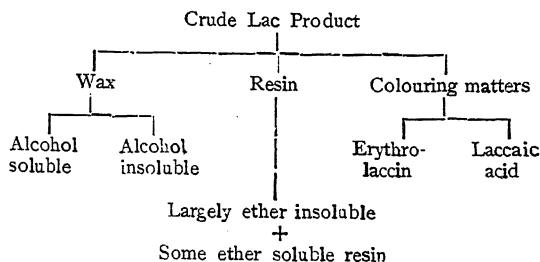
Department of Chemistry, University of Delhi, Delhi-6

THE lac insect *Laccifer lacca* which grows on specific host trees is known to produce a secretion product stick-lac, consisting of a complex mixture of organic compounds. Broadly speaking they are divided into three main groups: wax, resin and colouring matters of quinonoid nature.

The crude stick-lac is generally washed extensively with water when a part of the colouring matters that is soluble in water is removed. This compound named laccaic acid, has been investigated by Dimroth<sup>1</sup> and his co-workers in the early part of this century. It seems to be an anthraquinone derivative but its structure is still uncertain. The water washed product is known as seed-lac, which retains the waxes and another anthraquinone pigment, erythrolaccin whose constitution has recently been shown to be 1:2:5:7 tetrahydroxy-3-methyl anthraquinone.<sup>2</sup> The seed-lac is further purified by extraction with cold alcohol which leaves behind the waxes which are insoluble in cold alcohol and the alcohol soluble resin is decolourised by bleaching agents like sodium hypochlorite, when the product of commerce known as shellac is obtained.

The chemical investigation of lac is attended by many difficulties, the chief one arising from the lack of homogeneity of the samples. The stick-lac which is the crude product is the most reliable of the three. Its composition also appears to depend on the host trees and the age of the material. Polymerisation and hydrolysis are the two processes that appear to happen extensively during the storage of the samples. Though these factors have been recognised from the beginning, no systematic attempt has been made to overcome them. Consequently the literature reveals diverse type of conclusions often contradictory and not reproducible.

The early investigations of Nagel,<sup>3</sup> Tschirch<sup>5</sup> and their co-workers in Germany establish that the resins are a mixture of hydroxy acids, polymerised to different degrees with the formation of ester, lactone and lactide linkages. So far the constitutions of only two of the hydrolysis products of the resin have been completely worked out; aleuritic acid<sup>3</sup> and shellolic acid.<sup>4</sup> The exact number and nature of the wax components are also doubtful. The following scheme summarises the present position regarding the various components of stick-lac.



The lac larvæ are tiny red nymphs measuring 0.5 cm. in length and half as much in breadth. The female insect, at the time of maturity, is largely covered with a crust of the secretion product extended continuously over the tender twigs. It contracts the body, lays the eggs and escapes. The emerging larvæ crawl out and attach themselves on to the fresh tender shoots of the host tree. When emerging out they can be collected without much difficulty. It is possible that the chemical components of the larvæ may be identical or may resemble closely the genuine lac components. Hence an investigation of the larvæ has now been undertaken and a preliminary report is embodied in this note.

The larvæ were collected alive at the time of "swarming" in July 1961, stored in 70% alcohol and extracted within a week from the date of collection. The cold alcohol extract of the larvæ was filtered and the residue successively extracted with hot acetone, ether, petroleum ether and chloroform. This sequence of solvents was found to be the most suitable in view of the moisture content of the larvæ. Hot acetone extracted the resin and a part of the wax. The other solvents removed the rest of the wax esters. The residue, free from the wax and resin, contained the colouring matters which were extracted with sodium hydroxide. The following scheme gives the various fractions extracted.

Larvæ in 70% alcohol → Cold alcohol extract A.  
Residue → extracted with hot acetone →  
Extract B.

Residue → extracted with hot ether →  
Extract C<sub>1</sub>.  
Residue → extracted with hot petroleum  
(60-80°) → Extract C<sub>2</sub>.  
Residue → extracted with hot chloroform →  
Extract C<sub>3</sub>.

All the three extracts gave the same solid m.p. 94° C. and were combined as extract C.

Residue → N.NaOH followed by acidification  
→ Extract D.

#### WAX

The total wax was isolated from extracts B and C. Extract B, on cooling, deposited practically all the wax, leaving behind the resin in solution. This wax was soluble in hot alcohol, cold benzene and petroleum ether. Chromatography on neutral alumina gave no fraction whose composition and properties corresponded to saturated or unsaturated hydrocarbons. Two ester fractions were isolated, m.p. 80° and 55° C. The former was sparingly soluble in hot alcohol, showed absorption at 1742 cm.<sup>-1</sup> in the infra-red and no distinct absorption in the ultraviolet. The analytical value (C, 80.4, H, 14.7%) indicated a saturated ester. The second compound was more soluble in alcohol, showed absorption at 1742 cm.<sup>-1</sup> in the infra-red and no distinct absorption in the ultraviolet. The analytical value (C, 76.1, H, 13.4%) indicated a hydroxy ester. It may be mentioned here that from stick-lac the isolation of an ester m.p. 82° C. and a hydrocarbon m.p. 55° C. were reported by Tschirch and co-workers.<sup>5</sup> The results of these authors were contradicted by Chibnall and co-workers<sup>6</sup> who found only alcohols and no esters, hydrocarbons or acids from the hot alcohol soluble fraction of stick-lac.

Extract C was found to contain a saturated ester, m.p. 94° C. (U.V. no distinct absorption; I.R. 1745 cm.<sup>-1</sup>; C, 80.7, H, 13.6%). It was insoluble in hot alcohol and quite similar to the fraction lacceroyl laccerate isolated by Gascard<sup>7</sup> from stick-lac. However Chibnall *et al.* (*loc. cit.*) claimed it to be a mixture of homologous esters. The present investigation of the larvæ does indicate the presence of hot alcohol soluble esters and is partly in agreement with the results of Tschirch and co-workers on stick-lac. Further work on the nature of the pure wax components is in progress.

#### RESIN

Extract A and extract B, left after the separation of wax, provided the total resin present in the larvæ. Unlike the resin from stick-lac which has been reported to contain about 20% of ether soluble soft resin, the larvæ contained mainly ether insoluble hard resin. It was purified from traces of wax and colouring matters

by passing through a column of neutral alumina. The wax was readily eluted with benzene followed by the resin with alcohol containing acetic acid. The colouring matters were held to the column. The hydrolysis products of the resin are under investigation.

#### COLOURING MATTERS

Extracts A and C gave practically no colouring matters. Only fraction B gave a small amount of laccaic acid. It is interesting that the larvæ do not contain the alcohol soluble erythrolaccin which should have been present in extract B. The residue after the removal of the wax and resin retains practically all the quinonoid material present in the larvæ. They are apparently present in a combined state. Solvents like pyridine, phenol and water do not extract them appreciably. Drastic treatment with boiling dil. HCl liberated the quinones which could be extracted with cold methanol or hot acetone. However cold N.NaOH (H<sub>2</sub> atm.) extracted the quinones instantaneously with a pronounced pink colour, which on acidification gave two products, a water soluble and methanol soluble quinone and a second one which was insoluble in organic solvents as well as water. The latter contained nitrogen and presumably the condition in which the quinone is present in the larvæ.

#### SUMMARY

Summarising the results, the larvæ contain primarily wax esters, ether insoluble hard resin and the water soluble laccaic acid. The wax alcohols, acids, the quinone erythrolaccin and the soft resin are presumably later decomposition products, since negligible amounts of them are present in the larvæ.

Our thanks are due to the Director, Lac Research Institute, for the supply of fresh larvæ.

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## A HISTORY OF CHEMISTRY\*

PROF. PARTINGTON'S bold enterprise to bring out a monumental work on the history of chemistry in four sizable volumes will be widely welcomed by all chemists. Study of the growth of human achievements in science through the ages is itself a fascinating field of research and persons so interested would welcome a guide book on the subject which will lead them to original sources where authentic information could be had. Although there are quite a number of books on the history of chemistry many of them are confined either to particular aspects of the subject or to particular periods in its growth. Even among those which are of a comprehensive nature not all indeed are based on original sources. In this respect the two well-known reference books to which a discriminating student of the history of chemistry looks up for information are *Histoire de la Chimie* by F. Hoefer which was published in two volumes in 1842-43 (2 Ed., 1866-69), and *Geschichte der Chemie* by H. Kopp published in four volumes in the years 1843-47. These books themselves are more than a century old, and researches during these years have no doubt led to considerable modifications in the material originally presented in them. These, however, remain scattered in periodical publications and occasional monographs, many of which are not easily accessible to chemists. Thus there is at present a need for such a publication as Professor Partington has undertaken in which it is expected that not only these changes will be incorporated, but that the subject itself will be carried nearer to the modern period. Readers who are familiar with Professor Partington's *A Short History of Chemistry* will know what exactly to expect in the present work. As the author says in the preface it is in fact an enlargement of the *Short History*, but the treatment is more detailed, a larger number of original sources have been consulted, and references have been given to all of them.

The general plan is to take the scientists in the chronological order, give a short biography of the scientist, enumerate all his written works, and critically evaluate his contributions in the context of those of the earlier workers and the general scientific background of the times. The reference material has been systematised and extensive blocks of quotations which may sometimes lead to monotony have been replaced by carefully selected portions, interspersed by explanatory text. While we defer a critical review of this work to a future date, after all the four volumes of the set have been published, we shall here limit ourselves to mentioning the

chief contents of the volume under reference, which though the second in the series is the first to be published.

Volume II roughly covers the period from 1500 A.D. to the late 18th century, excepting French Chemistry which will form the content of Vol. III. Thus it brings out two important transition periods in the history of chemistry, firstly, the period in which alchemy gave way to technological chemistry on the one hand, and iatrochemistry on the other, and secondly, the period in which chemistry emerged as an independent science, associated with the work of Boyle and his contemporaries, and the establishment of the phlogiston theory by Becher and Stahl.

Appropriately enough the volume starts with "one of the most prophetic of giants in the history of science"—Leonardo da Vinci (1452-1519), who besides being a great artist, an expert musician, an accomplished civil and military engineer and architect, was a man of very varied scientific ability. His varied researches in chemistry as revealed from his manuscripts *Codice Atlantico* are enumerated. The first illustration in the book is a drawing of Leonardo da Vinci's, taken from the *Codice Atlantico*, representing a chemist's furnace with two alembics.

Probably historically the pioneer in the field of metallurgical chemistry was Agricola (Georg Bauer), 1494-1555, who first taught classics, later studied medicine and became a town physician in a mining area where as physician to the miners he used every opportunity to see and study all kinds of mining and metallurgical processes, and spent his all in these studies. His book *De Re Metallica* is a classic of mining and metallurgical technology.

Rightly enough a whole chapter (III) is devoted to Paracelsus (1493-1541), afterwards called Theophrastus Bombast von Hohenheim, one of the most curious personalities in the history of chemistry. Paracelsus is said to have written a great number of books. Their number has been given as 364 of which 122 titles are of chemical interest. Two works of special interest are *De Natura Rerum* and *Archidoxis* or Chief Teachings comprising ten books disclosing the genuine ways of making quintessences, arcanums, magisteries, elixirs, etc. Paracelsus wrote in a magic style "to conceal his arcana from vulgar alchemists", and only later Paracelsists gave his chemical prescriptions their modern form and utility. In turning attention away from the transmutation of metals, (although he still believed in the possibility of

transmutation) and towards the applications of chemistry to medicine Paracelsus performed a valuable and lasting service. Paracelsus is usually studied by the works of his followers who not only replaced his difficult German with good Latin, but also eschewed the wilder mysticisms of their eccentric master.

Another chapter (VI) is devoted to Van Helmont (1579-1644), who according to Boyle was "an author more considerable for his experiments than many learned men are pleased to think him." Van Helmont's influence to the development of medicine was great and he raised chemistry to a high rank in the eyes of medical men. He disputed the prevailing views on elements. In his treatise "the fiction of elementary complexions and mixtures" Van Helmont rejects the theory of the "four elements" and the "three principles", and introduces his own theory that water is the primary element. He also explains his new views on gas (which he derives from the Greek word *chaos*). Boyle frequently quotes Van Helmont and refers to him as an authority.

The philosophical background as represented by Gassendi (1592-1655), Bacon (1561-1626) and Descartes (1596-1650), especially the atomic theory, as far as it is of interest in chemistry, has been adequately dealt with in three chapters (XI, XII and XIII). Descartes' name (his full name is Renè du Perron Descartes which has been latinised as Renatus Cartesius, whence cartesian and cartesianism), is memorable both in mathematics as the founder of analytical geometry, and in philosophy. He represents a

complete break with the scholastic philosophy of Aristotle, and the introduction of the rational explanation of phenomena on the basis of mathematical physics. His ideas which are not usually mentioned by historians of chemistry, are however of particular significance in understanding the views of Boyle, Mayow and Lemery.

Robert Boyle (1627-91) and his contributions to chemistry form the content of Chapter XIV. Boyle has been rightly called the founder of modern chemistry. He realised that chemistry is worthy of study for its own sake and not merely as an aid to medicine or as alchemy. He raised chemistry to a point where physicists recognised it as a real and important science, and indeed as an essential part of natural philosophy.

The phlogiston theory as originally put forward by Becher (1635-82), and subsequently developed by Stahl (1660-1734), forms the two Chapters XVII and XVIII. The last two chapters are devoted to a number of other 18th century chemists.

As we have mentioned earlier Professor Partington's efforts in bringing out this great work represent a bold enterprise and readers will look forward with interest to the other volumes in this series. There is no doubt that these volumes should form an essential addition to all scientific libraries.

A. S. G.

\* *A History of Chemistry*, (Vol. II), by J. R. Partington (Macmillan & Co., Ltd., St. Martin's Street, London W C. 2), 1961. Pp. xxiv + 795. Price £5.5 *sh.*

## VIBRATION SPECTRUM OF LITHIUM FLUORIDE

**S**TUDIES of the infra-red behaviour of crystals of simple structure and composition enable one to determine the characteristic modes and frequencies of free vibrations of the atomic nuclei in the crystal structure. The alkali halides play an important role in this respect. Closely following his recent work on the infra-red studies of sodium chloride Sir C. V. Raman has reported the results of his investigations on the vibration spectrum of lithium fluoride and the evaluation of its specific heat (*Proc. Ind. Acad. Sci.*, 1962, 55, 131). The experimental study consists in recording the infra-red transmission curves of lithium fluoride crystals of varying thicknesses, down to a tenth of a millimetre, with a Leitz spectrophotometer using NaCl optics for the range 1-15  $\mu$ , and KBr optics for the range 13-25  $\mu$ .

As in the case of sodium chloride Sir C. V. Raman finds that the spectrum of free vibrations of lithium fluoride consists of nine discrete fre-

quencies. The principal frequency is the one in which the nuclei of lithium and fluorine oscillate against each other in opposite phases. In the infra-red transmission curve this appears as a sharply-defined minimum of second-order absorption at 9.84  $\mu$ . The thinner the crystal the more striking is the appearance of this minimum in the curve. This enables the precise determination of the principal frequency as 508  $\text{cm}^{-1}$  (19.68  $\mu$ ). This determination leads to the calculation of the eight other frequencies in the free vibration spectrum of lithium fluoride. They are 417, 384, 210 ( $\approx$  210)  $\text{cm}^{-1}$  which are cubic modes, and 435 ( $\approx$  435) and 263 ( $\approx$  263)  $\text{cm}^{-1}$  which are octahedral modes. A theoretical computation of the atomic heats of lithium fluoride based on the above data is found to be in satisfactory agreement with the experimentally determined values over the range of temperatures 0-500° K.

## LETTERS TO THE EDITOR

ORBITAL VALENCE FORCE  
CONSTANTS OF PLANAR  $XY_3$   
MOLECULES

HEATH AND LINNET<sup>1</sup> introduced the orbital valency force field to explain the out-of-plane vibrations of planar molecules. Here, an attempt has been made to evaluate the orbital valency force constants of  $BO_3$ ,  $BI_3$  and  $AlCl_3$  molecules.

The planar  $XY_3$  molecules have the symmetry  $D_{3h}$ . Hence, according to selection rules, there are  $(a_1' + a_2'' + 2e')$  types of vibration.

The potential function can be written as:

$$2V = 2B' \sum \Delta r_{ij} + K_1 \sum \Delta r_{ij}^2 + K_\beta' \sum \Delta \beta_{ij}^2 - 2B \sum_{jk} \Delta R_{jk} + 2A \sum_{jk} \Delta R_{jk}^2 \quad (1)$$

where  $i$  represents the central atom and  $j, k$ , etc., the outer atoms;  $\Delta r_{ij}$  is the increase in bond length  $r_{ij}$  and  $R_{jk}$  is the increase in the distance between non-bonded atoms  $j$  and  $k$ ;  $\Delta \beta$  is the angular displacement;  $B'$ ,  $K_1$ ,  $K_\beta$ ,  $B$  and  $A$  are constants. The second and the third terms are the orbital valency force field terms. The fourth and fifth are those which represent the repulsion between the non-bonded atoms.

The final expressions for the normal frequencies are:

For the  $a_1'$  type

$$\lambda_1 = (K_1 + 6A) \frac{1}{m_2} \quad (2)$$

For the  $e_1'$  type

$$\lambda_2 + \lambda_3 = \left( K_1 - \frac{3}{4} \frac{B}{Re} + \frac{3}{2} A \right) \left( \frac{1}{m_2} + \frac{3}{2m_1} \right) + \left( K_\beta + \frac{9}{4} \frac{B}{Re} + \frac{3}{2} A \right) \left( \frac{1}{m_2} + \frac{3}{2m_2} \right) - \left( 2A - \frac{B}{Re} \right) \frac{9}{4m_1} \quad (3)$$

$$\lambda_2 \lambda_3 = \left[ \left( K_1 - \frac{3}{4} \frac{B}{Re} + \frac{3}{2} A \right) \left( K_\beta + \frac{9}{4} \frac{B}{Re} + \frac{3}{2} A \right) - \frac{9}{16} \left( 2A - \frac{B}{Re} \right)^2 \right] \left( \frac{1}{m_2^2} + \frac{3}{m_1 m_2} \right) \quad (4)$$

For the  $a_2''$  type

$$\lambda_4 = \left( K_\beta + 3 \frac{B}{Re} \right) \left( \frac{1}{m_2} + \frac{3}{m_1} \right) \quad (5)$$

where  $m_1$  is the mass of the central atom and  $m_2$  is the mass of each outer atom;  $K_1$ ,  $K_\beta$ ,  $A$  and  $B/Re$  are constants;  $\lambda$  is related with the observed frequency  $\nu$  by the relation

$$\lambda = 4\pi^2 c^2 \nu^2$$

All the four force constants could be obtained from the four observed vibrational frequencies,

In the case of  $AlCl_3$ , where there are only three observed frequencies, the orbital valence force field relation  $2A = 13B/Re$  is used and the three major force constants are evaluated.

The observed frequencies of the planar  $XY_3$  molecules used in this investigation are given in Table I.

TABLE I  
Observed frequencies of planar  $XY_3$  molecules

Molecule	$a_1'$ $\sigma_1$	$e_1'$		$a_2''$ $\sigma_4$	Reference
		$\sigma_2$	$\sigma_3$		
$BO_3$ ..	939	1284.5	603.75	712	(2)
$BI_3$ ..	190	704	100	336	(3)
$AlCl_3$ ..	541	348	808	..	(4)

The values of force constants are listed in Table II.

TABLE II  
Orbital valency force constants of planar  $XY_3$  molecule

Molecule	$K_1$	$K$	$A$	$B$
				$Re$
$BO_3$ ..	4.580	0.592	0.614	0.094
$BI_3$ ..	1.814	0.178	0.145	0.018
$AlCl_3$ ..	3.791	0.858	0.384	..

One of the authors (K. V. R.) wishes to thank the Council of Scientific and Industrial Research for the award of a Junior Research Fellowship.

Department of Physics, K. VENKATESWARLU,  
Annamalai University, K. V. RAJALAKSHMI,  
Annamalainagar, January 6, 1962,

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### NUCLEONIC POLARIZATION OF 424-MeV PROTONS BY CARBON

EXPERIMENTAL observations on the nucleonic polarization for the elastic scattering of 424-MeV protons by C have been obtained by E. Heiberg.<sup>1</sup> Assuming the validity of the first Born approximation for the nuclear scattering of such high energy protons and following Malenka<sup>2</sup> an expression for the nucleonic polarization was derived by Shah and Gatha.<sup>3</sup> The expression for the nucleonic polarization  $P(\bar{S})$  in the above approximation is given by

$$P(\bar{S}) = - \frac{\gamma y}{1 + \beta^2 y^2} \quad (1)$$

where

$$\gamma = \frac{\epsilon k \bar{a}}{(1 + \epsilon^2)}$$

and

$$\beta^2 = \frac{k^2 \bar{a}^2}{4(1 + \epsilon^2)}$$

with

$$\bar{a} = a \times A^{1/3}$$

$$\bar{S} = S \times A^{1/3}$$

$$\epsilon = \frac{\bar{n}_2}{\bar{n}_1}$$

$S = 2k \sin \theta/2$ ,  $y = h'/h$  and  $a$  is a constant, whereas  $\bar{n}_1$  and  $\bar{n}_2$  are the parameters of the complex refractive index of the nucleus and

$$h = 1/\bar{S} \int_0^\infty \rho(\bar{r}) \sin(\bar{S}, \bar{r}) \bar{r} d\bar{r}.$$

In the present investigation,  $y$  is calculated using the revised characteristic nuclear density distribution given by Gatha and Shah. We have taken the value of  $\bar{n}_1 = 8$  mbn as given by the Jastrow's Model<sup>4</sup> at 340 MeV since the curve flattens out after 300 MeV.  $\bar{n}_2$  has been taken equal to 13.68 mbn from the experimental observations of the scattering cross-sections for the  $(n, n)$  and  $(n, p)$  scattering respectively. Using the formula  $\bar{n}_2 = (\sigma_{nn} + \sigma_{np})/4$  we have tried different values of  $a$  between 0.05 and 0.2 and we have found that  $a = 0.1$  gives the best agreement between the theoretical and the experimental values of  $P(\bar{S})$ . The theoretical values of  $P(\bar{S})$  have been calculated from equation (1) and the same is plotted against  $\bar{S}$  in

Fig. 1. The experimental values of  $P(\bar{S})$  as obtained by Heiberg is also plotted together with their probable errors.

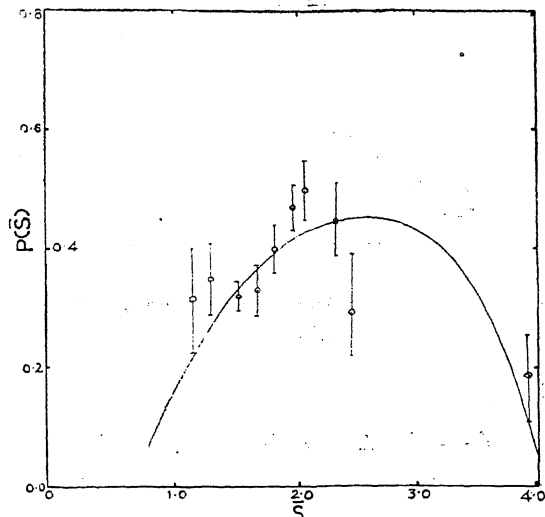


FIG. 1. The nucleonic polarization  $P(\bar{S})$  as a function of  $\bar{S}$  for 424 MeV protons by Carbon.

The close agreement between the theoretical and experimental values of  $P(\bar{S})$  strengthens the validity of the concept of the characteristic nuclear density distribution proposed by Gatha and Shah.

Bhavan's College,  
Andheri, Bombay-58,  
January 25, 1962.

G. Z. SHAH.  
B. M. THAKER.

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### EMPIRICAL FORMULA FOR THE EXCESS COMPRESSIBILITY OF BINARY LIQUID MIXTURES

THE authors are engaged in a systematic study of the thermodynamic behaviour of binary liquid mixtures with triethylamine, a polarisable, weakly polar molecule, as a common component. The present communication describes the compressibility behaviour of binary solutions of the following liquids in triethylamine: benzene, toluene, *p*-xylene, *o*-xylene, cyclohexane, *o*-nitrotoluene, aniline, methylaniline, benzylamine *o*-chloroaniline, pyridine and nitrobenzene.

Ultrasonic velocity is determined using a single crystal interferometer, working at 720 Kc./sec. Solutions are prepared by mixing

weighed amounts of pure liquids. Densities are determined by the hydrostatic method. Adiabatic compressibility is evaluated, with the above data, with a probable error of  $\pm 0.2\%$ .

In presenting such data the usual practice is to represent the adiabatic compressibility as a function of concentration. A deviation has been made from this practice and excess compressibility  $\beta^E$  (defined as the difference between the measured value of the compressibility of a given mixture and that of an ideal mixture of the same composition) is represented as a function of molar concentration. Typical data for a few mixtures are shown in Fig. 1. Such a representation gives us an idea of the extent to which the compressibility deviates from the ideal (linear) mixture law. The excess compressibility is zero for mixtures of benzene, toluene and *p*-xylene, positive in the case of cyclohexane and negative in all other cases.

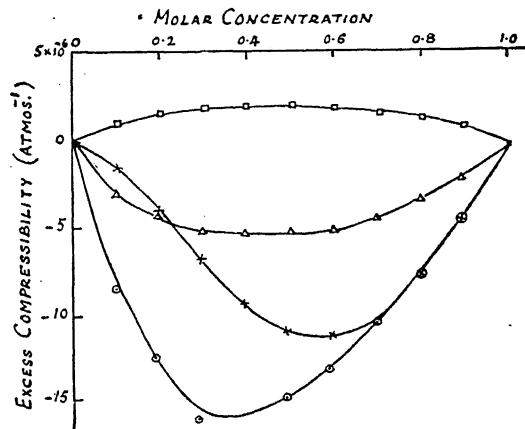


FIG. 1. Variation of excess compressibility with molar concentration.

□ cyclohexane;      △ pyridine;  
× nitrobenzene and    ⊙ aniline.

The excess compressibility conforms to the relation

$$\beta^E/n_1n_2 = A + B(n_1 - n_2) + C(n_1 - n_2)^2$$

where  $n_1$  and  $n_2$  are molar concentrations of the component liquids 1 and 2.  $A$ ,  $B$  and  $C$  are constants characteristic of the system. This type of relation was first suggested by Barker<sup>1</sup> in representing free energy data of liquid mixtures. The constants  $A$ ,  $B$  and  $C$  for different systems have been evaluated to give as close a fit as possible to  $\beta^E$  vs. concentration graphs. The values of these constants are given in Table I.

The authors thank the Ministry of Scientific and Industrial Research, Government of India,

TABLE I

System	$A \times 10^6$	$B \times 10^6$	$C \times 10^6$
Triethylamine-cyclohexane	.. 8.0	- 2.26	4.86
" <i>o</i> -xylene	.. -18.0	6.25	-12.56
" pyridine	.. -20.0	5.21	- 5.21
" benzylamine	.. -33.0	5.21	4.85
" <i>m</i> -tolylaniline	.. -37.0	4.72	6.67
" nitrobenzene	.. -44.0	-16.92	24.57
" aniline	.. -53.0	35.18	23.37
" <i>o</i> -chloroaniline	.. -60.0	10.42	10.42

for financial assistance to this scheme. We thank Dr. J. Bhimasenachar for his valuable suggestions and encouragement.

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Sri Venkateswara S. V. SUBRAHMANYAM.  
University,  
Tirupati (India),  
March 9, 1962.

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## THE LINE OF THE NARMADA AND SON VALLEYS

THE purpose of this letter is to draw the attention of geologists to some facts concerning the limits of distribution of the Vindhyan and Gondwana rocks in the Narmada-Son area in northern India, the implications of which appear to be interesting.

Looking at the map of India, it will be noticed that the Narmada and Son valleys (excluding their upper reaches) lie almost in a straight line, a line that may be significant in the tectonic structure of India. North of this line no Gondwana rocks are found; south of the line no Vindhyan rocks occur until the Wardha valley is reached. To the north of the line the Deccan Trap lavas (with in places Lameta beds) rest directly on the Vindhyan, without the intervention of any Gondwana beds. To the south of the line the Deccan Trap lavas (with in places Lameta beds) rest on the Gondwanas or on the Archæan rocks, the Vindhyan being absent. In places the Vindhyan and Gondwanas come to within 15 to 20 miles of each other, as for example north and south of Hoshangabad, and north and south of Jabalpur, the alluvium of the Narmada valley separating them.

Where the Son river flows in a northerly direction before turning sharply to the east, some 40 miles S.S.W. of Rewa, the Vindhyan and Gondwanas actually come to within one mile of each other, being separated by a narrow strip of Bijawar rocks. This area has not been studied since R. D. Oldham and others mapped it at the end of the last century.<sup>1</sup> It might well

repay further examination, for on the north side of the Bijawar strip there occurs a full development of the Vindhyan, while on the south side the Upper Gondwanas are found in force. Yet neither formation extends across the thin Bijawar strip. What does all this signify?

It has for long been surmised that the Narmada river flows in a faulted depression, and recent drilling done by the Groundwater Section of the Geological Survey of India shows that the alluvium of the Narmada valley in the Piparia region has in places a thickness of from 800 to over 1,000 feet, the base of the alluvium in the latter case being only a little above sea-level.<sup>2</sup> The measure of the faulting that has taken place since the Traps were erupted may be gauged by studying the level of the Trap-Lameta junction. Thus 24 miles N.N.W. of Jabalpur, above Katangi, the base of the Trap, according to V. D. Choubey, comes at 1,950 feet, resting on Lametas. In Jabalpur town the same horizon comes at about 1,550 feet; while on the south bank of the Narmada south-west of Jabalpur it comes at about 1,200 feet.

It is generally believed that the basin of deposition of the Vindhyan of northern India had its southern margin along the line of what are now the Narmada and Son valleys, with a land barrier to the south; while the northern margin of the later Gondwana basin of central Madhya Pradesh appears to have lain along the same line, with land to the north. It is of course conceivable that Gondwanas were deposited further north and were completely removed by denudation before the eruption of the Deccan Trap, though there is no evidence to suggest this. It is remarkable, therefore, that the same line should at one time mark the southern limit of the Vindhyan, and at a later time the northern limit of the Gondwanas.

It thus appears that the Narmada-Son line may have been a line of weakness from early times, with the areas to the north and south moving up and down relatively to each other along this line. If this is correct, then the line must be regarded as a feature of special significance in the history of peninsular India. The views of other geologists on this matter would be welcomed.

Dept. of Applied Geology,  
University of Saugar,  
Sagar, M.P., March 22, 1962.

W. D. WEST.

### A METHOD FOR DETERMINING DOMAIN SIZE AND LATTICE STRAIN IN A DEFORMED METAL

It is now generally accepted that the broadening of X-ray reflections from a cold-worked metal is due to one or more of three effects of plastic deformation, viz., diminution in size of coherently diffracting domains, strains in the lattice and stacking faults. As a quantitative estimate of each of these broadening effects is essential for understanding the mechanism of plastic deformation in metals, attempts have been made to separate them from observed line profiles. The present note deals with the problem of separation of these effects in hexagonal close-packed structures purely from observed X-ray line-breadths. Although not comparable to the widely used Fourier Analysis method<sup>1</sup> on theoretical grounds, the method proposed here has the advantages of simplicity and quickness over the latter.

In hexagonal close-packed structures, Debye-Scherrer reflections (HKIL) with  $H+K = 3N \pm 1$ , where  $N$  is zero or an integer and  $L \neq 0$ , are broadened by stacking faults and can be utilised to arrive at the fault parameter. The other reflections can be affected by small domain size and lattice strain only and hence their integral breadths may be used for separation of these two effects. Such a separation is here attempted in the case of deformed cobalt powder where the hexagonal lattice has previously been shown<sup>2</sup> to be affected mainly by deformation stacking faults and an isotropic distribution of lattice strain.

Following Kochendoerfer<sup>3</sup> who first conceived of the possibility of both domain size and lattice strain simultaneously contributing to the observed X-ray line broadening, Hall<sup>4</sup> proposed a separation of the two effects by plotting the breadths of reciprocal lattice points against their distances from the origin. A straight line with a positive intercept would be expected if the two broadening effects are simply additive, but such a linear plot was rarely obtained in practice and the intercept was found to be even negative in one case. Hall and Williamson,<sup>5</sup> however, later pointed out that the cumulative broadening effect of both domain size and lattice strain is dependent on the actual broadening profile in each case.

After the graphical separation<sup>6</sup> of the  $K_{a1}$  components from the respective composite doublets in the photometric or diffractometer record, the pure diffraction broadening ( $\beta$ ) is arrived at for each X-ray reflection by correcting the observed breadth ( $B$ ) for instrumental

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2. Roy, A. K., *Proc. 44th Ind. Sci. Cong.*, 1957, Pt. III, 197.

broadening (b). The following equations due to Scherrer,<sup>7</sup> Warren and Biscoe,<sup>8</sup> Taylor<sup>9</sup> and Anantharaman and Christian<sup>10</sup> respectively have been used for the purpose:

$$\beta = B - b. \quad (1)$$

$$\beta = (B^2 - b^2)^{1/2}. \quad (2)$$

$$\beta = [(B^2 - b^2)^{1/2} \cdot (B - b)]^{1/2}. \quad (3)$$

$$\beta = B - \frac{b^2}{B}. \quad (4)$$

Equations (1) and (2) are respectively based on Cauchy and Gaussian line shapes for all the components involved in the relationship. Profiles of Debye-Scherrer reflections from metals are actually intermediate to these two in most cases and hence equations (3) and (4) derived for intermediate line shapes may be considered more satisfactory for any preliminary line-breadth analysis. Equation (4) has been used in the present work as it has been shown<sup>10</sup> to lead to the most reliable and consistent results of all when applied to the study of the anomalous X-ray line broadening in martensitically transformed hexagonal cobalt.

Following earlier workers the values of pure diffraction broadening for different reflections may be used to calculate the apparent domain size ( $\eta = \lambda/\beta \cos \theta$ ), the isotropic lattice strain ( $\epsilon = \beta \cot \theta/4$ ) or the isotropic stress on the lattice ( $\sigma = E_{hkl}/E$ ) where  $\lambda$ ,  $\theta$ ,  $E_{hkl}$  represent the wavelength of the characteristic X-radiation used, the Bragg angle and Young's modulus in a direction perpendicular to HKIL planes respectively. The mean deviation from mean values for one of the broadening effects ( $\eta$ ,  $\epsilon$  or  $\sigma$ ) should be expected to be very small, i.e., < 5% if that contributes exclusively to the observed broadening. An indication of possible contribution from both domain size and strain, isotropic or anisotropic, may be had when the percentage mean deviation from mean value is large in every case. A gradual decrease of  $\eta$  and  $\epsilon$  or  $\eta$  and  $\sigma$  also suggests a simultaneous combined contribution from domain size and strain or domain size and stress respectively. For deformed hexagonal cobalt powder the percentage mean deviation values as also the gradual decrease of  $\eta$  and  $\epsilon$  with  $\theta$  (Table I) point to a predominant isotropic lattice strain effect and a subsidiary domain size effect.

It is now generally agreed<sup>11</sup> that the diffraction broadening is Gaussian for lattice strain and Cauchy for small domain size. We can therefore apply the relevant equations (1), and (2) as follows:—

$$\beta_D = B_0 - b. \quad (5)$$

$$\beta_S = (B^2 - B_0^2)^{1/2} \quad (6)$$

where  $\beta_D$ ,  $\beta_S$  and  $B_0$  represent pure domain size broadening, pure strain broadening and the compound of instrument and domain size broadening respectively.  $B_0$  can be eliminated by combining equations (5) and (6) to give

$$B^2 = \beta_S^2 + \beta_D^2 + b^2 + 2b\beta_D. \quad (7)$$

The above derivation is an improvement over Hall's as the assumptions here are only the inevitable ones concerning the profiles leading to  $b$ ,  $B_0$  and  $B$ . Substituting for  $\beta_D$  and  $\beta_S$  in equation (7) in terms of  $\eta$  and  $\epsilon$  or  $\sigma$  respectively and utilising values of  $B$  and  $b$  for two reflections, preferably with low and high  $\theta$  values, the apparent domain size and lattice strain values may be evaluated. These can be used to calculate  $B$  according to equation (7) for all reflections. The efficacy of this method will be revealed by the value of the mean deviation between observed and calculated breadths for a number of reflections of the cold-worked metal. The last column of Table I based on

TABLE I  
Analysis of X-ray line broadening in deformed cobalt powder

(Crystal-reflected Ni K $\alpha$  radiation: Camera radius, 45.0 mm.)

HKIL	$\theta$ in $10^{-3}$ radians	$B$ in $10^{-3}$ radians	$\beta$ in $10^{-3}$ radians	$\eta$ in Å	$\epsilon \times 10^{-3}$	$\sigma$ in $10^8$ dynes/cm. <sup>2</sup>	$B_{calc.}$ (for $\eta = 670$ Å $\epsilon = 4.05 \times 10^{-3}$ ) in $10^{-3}$ radians
1010	9.16	13.58	7.40	242	4.49	13.95	13.58
0002	9.87	14.49	7.77	234	4.36	9.24	14.50
1120	9.49	19.96	15.44	143	4.39	10.10	19.12
2020	9.56	23.29	19.37	132	4.11	12.85	23.31
1122	10.07	24.33	20.17	130	4.10	8.36	24.34
0004	11.80	27.76	22.74	125	4.07	8.58	27.73
Percentage mean deviation from mean value:				28.0	3.8	18.3	..
Percentage mean deviation of $B_{calc.}$ from observed $B$ :				0.7			

a domain size of 670 Å and an isotropic strain of 0.405% records as low a value for such mean deviation as one could hope for. It has to be pointed out, however, that this method cannot be applied for cases where complexities like anisotropy of domain size are supposed to affect X-ray diffraction broadening.

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### A NOTE ON THE DETERMINATION OF TRANSPORT NUMBER OF COUNTERIONS IN CHARGED MEMBRANES

IN recent years, a number of papers have been published about measurements of membrane potentials and Hittorf transport numbers of counterions ( $t^+$ ) and of water ( $t_w$ ) and the data have been used to test various theories of membrane potentials which have been reviewed and reformulated by Hills *et al.*<sup>1,2</sup> Using thin cross-linked polymethacrylic acid membranes, they have shown the existing theories to be inadequate to describe the membrane potentials observed in concentrated solutions. Even in dilute solutions membrane cell e.m.f.s. calculated by the substitution of observed  $t^+$  values in equation (13) of their paper<sup>2</sup> and its integration carried out numerically by means of Simpson's rule are less than observed e.m.f.s. of corresponding cells (Fig. 3 of their paper). Utilising the same data, it is shown<sup>3</sup> by graphical integration of equation (13) that the observed transport numbers are significantly lower than theoretical values.

Confining attention to concentration range  $> 0.1$  N, it can be stated from the data presented herein that this discrepancy between the two types of transport number is due to the neglect of the effect of current density on the observed transport numbers. Hills *et al.*, in their work have determined the transport number  $t^{+0}$  of potassium ion at one value of the current for any given electrolyte concentration.

Experimental results concerned with the Hittorf transport number ( $t^+$ ) of  $\text{Na}^+$  ion at  $30^\circ\text{C}$ . in cross-linked phenol sulphonic acid membranes are given in Table I as a function of current density.

An H-cell, each half cell  $\sim 300$  ml. capacity or  $\sim 50$  ml. in case of  $0.1$  N  $\text{NaCl}$  solution, bisected by a  $\text{Na}^+$  form membrane was used. Nonpolarizable  $\text{Ag-AgCl}$  electrodes of sufficient capacity to withstand passage of about 25

TABLE I  
Transport number  $t^+$  of  $\text{Na}^+$  at  $30^\circ\text{C}$ .

Conc. of solution	mA. cm. <sup>-2</sup>	0.505	1.010	2.525	5.050	10.100
0.005 N	$t^+$	0.997	0.931	0.901	0.858	0.804
0.01 N	$t^+$	0.997	0.981	0.960	0.915	0.847
0.10 N	$t^+$	0.651	0.820	0.820	0.909	0.868
		0.816*	..	..	0.909†	..
		0.868†	..	..	..	..

\* Value obtained when a calculated amount of  $\text{NaCl}$  was added to the anode chamber to compensate for its loss and the solution was stirred during electrolysis.

† Value obtained when a solution of  $\text{NaCl}$ ,  $0.1038$  N was circulated in the anode chamber.

coulombs of current, prepared according to the method of Brown<sup>4</sup> were used. Current was drawn from a mains operated d.c. power unit. A silver coulometer recorded the quantity of electricity passed. Generally, enough current to bring about a concentration change of about 10% was passed.  $0.005$ ,  $0.01$  and  $0.1$  N  $\text{NaCl}$  solutions were used. Concentration changes were estimated by titration against standard  $\text{AgNO}_3$  solution using  $\text{K}_2\text{CrO}_4$  as the indicator.

With external concentrations  $0.005$  and  $0.01$  N, the values of  $t^+$  increase as the current is decreased and with  $0.1$  N solution  $t^+$  increases, reaches a maximum and then begins to decrease with decreasing current strength. Kressman and Tye<sup>5</sup> have observed similar results with commercial membranes using  $0.1$  N solution in multicompartiment cells. Their explanation points clearly to the desirability of planning the experiments carefully to obtain unambiguous values for  $t^+$ . They have shown that the decrease in  $t^+$  with increase in current density is due to concentration polarization at the membrane surface facing the anode and finally bringing about the polarization of the membrane. Again the decrease in  $t^+$  with decrease in current is due to significant ionic diffusion coming in as a result of concentration differences built up during the period when the current necessary to bring about measurable concentration differences on either side of the membrane is passed. This decrease in  $t^+$  with decrease in current is absent when the external concentration is lowered to  $0.01$  N and to  $0.005$  N. Here it is apparent that there is absolutely no diffusion of electrolyte due to the ionic membrane exerting its full selectivity. As a result both the factors which affect ionic transport numbers namely membrane polarization and diffusion are eliminated at very low currents but not so at external concentrations  $< 0.1$  N where diffusion must be eliminated to get meaningful values for



$t^+$ . Only such values as are unaffected by the above factors and remain unambiguous should be used in testing the theories of membrane potentials. Full details including other aspects will be published elsewhere.

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# PHYSICO-CHEMICAL STUDIES ON COMPOUNDS RELATED TO MUREXIDE: KINETICS OF DECOMPOSITION OF TETRAMETHYL-MUREXIDE IN ALKALINE MEDIA

DURING our comprehensive investigations on the kinetics of decomposition of murexide in alkaline medium<sup>1</sup> we have studied the influence on the reaction rate of various factors including the specific influences of amines and of such metals which are known to form chelate compounds with murexide.<sup>2</sup> Interesting results obtained from these studies appeared to justify the extension of these investigations to various compounds related to murexide; the present communication refers to the spectrophotometric study on the kinetics of decomposition of tetramethylmurexide (TMM) in alkaline solutions.

A pure sample of tetramethyl murexide was obtained by the procedure suggested by Gysling and Schwarzenbach.<sup>3</sup> For this purpose tetramethyl alloxanthin was prepared from caffeine by following carefully the directions of Biltz.<sup>4</sup> Sodium hydroxide solutions were prepared from an Analar sample. Spectrophotometric measurements were made with a Beckman DU spectrophotometer equipped with a dual thermospacer set. The experiments reported here were carried out at 30° C.

An examination of the absorption spectrum of an aqueous solution of TMM indicated the existence of a maximum at  $\lambda = 530 \text{ m}\mu$ . Unlike murexide and certain related compounds such as indandionyl-azine barbiturate the wavelength of maximum absorption for TMM

remained unaffected on the addition of alkali.<sup>5</sup> Further at this wavelength the variation of optical density with concentration was linear. Kinetic studies were carried out by following the change in O.D. at  $\lambda = 530 \text{ m}\mu$  of TMM solutions containing varying amounts of NaOH, and identical initial concentration of TMM. In all the experiments reported here the concentration of NaOH was employed in much excess over that of TMM. Under these conditions the reaction obeyed first order law as is evident from the linear plots of  $\log (\text{OD})$  vs. time (see Fig. 1). From the slope of these plots

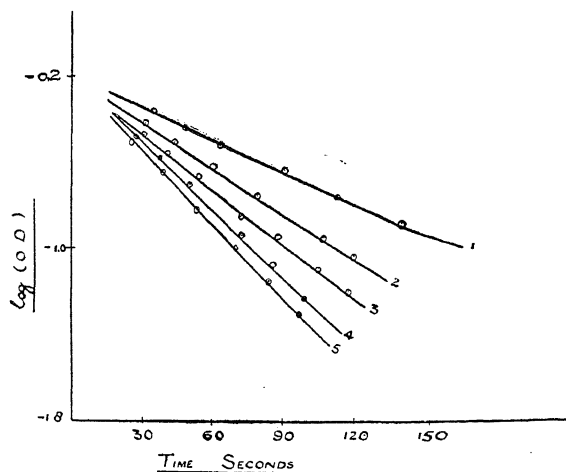


FIG. 1. Variation of  $\log (\text{OD})$  with time. Concentration of TMM 0.04 mM.; Concentration of NaOH, Curve 1-2 mM, Curve 2-2.5 mM, Curve 3-3 mM, Curve 4-3.5 mM, Curve 5-4 mM.

and the known initial concentrations of NaOH a value of  $6.02 \text{ sec.}^{-1} \text{ lit. mole}^{-1}$  was obtained for the rate constant ( $k$ ) of the reaction. Comparison of this value with the value of  $k$  for murexide indicates that the result of the substitution in the imido groups of murexide, unlike that of the replacement of the central azine atom by methine group,<sup>6</sup> is to enhance the rate of the reaction.

It may be pointed out that unlike the purpurate ion the tetramethyl purpurate does not have ionisable imido groups. The release of protons in the alkaline medium from these groups in the purpurate ion leads to an increase in the resonance energy of the system and to an addition of two more negative charges to the purpurate ion. The interaction with  $\text{OH}^-$  of purpurate ion (with three negative charges) and tetramethyl purpurate ion (with one negative charge) thus involves considerable difference in electrostatic repulsion.

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#### A PAPER CHROMATOGRAPHIC APPROACH TO THE PROBLEM OF "SOIL ENRICHMENT" BY EARTHWORMS

SINCE Darwin<sup>1</sup> carried out his study of earthworms in relation to soil enrichment, various approaches to this topic have been made.<sup>2-4</sup> Satchell<sup>2</sup> and Barley and Jennings<sup>3</sup> in their reviews have pointed out that worms select better soil rather than enrich it. It is only recently that Barley and Jennings<sup>3</sup> found that 6% of the non-available nitrogen ingested by worms is excreted in forms available to plants but there is no change in soluble amino-nitrogen, during the conversion of leaf protein into nitrogenous material on passing through the earthworm intestine rich in microflora. In case of a millipede, Bocock<sup>5,6</sup> has found a similar result.

These data are confirmed in the present work based on a different, i.e., paper chromatographic approach.

A comparative study was made for detecting ninhydrin positive material in worm casts, ordinary soil and subsoil. The material was collected from the Institute garden at Calcutta in the month of June. About 30 g. of soil (or cast) was heated for about 24 hours to drive the moisture and then treated with distilled water. The filtered extract was evaporated to a few drops in order to concentrate the solution. A one-dimensional ascending paper chromatogram, developed with two solvent systems separately, showed 4 different spots in worm casts, as well as in the ordinary top soil. The solvent systems were (1) 70% ethanol and (2) *n*-butanol: glacial acetic acid: water

(4: 1: 1). (Sub-soil from a depth of 18 inches exhibited no such ninhydrin positive material.) Thus it is seen that the passage through worm intestine does not increase the number of amino-nitrogen components in the soil. However, sub-soil from a depth of about 6 inches exhibited three such components, i.e., three spots in the chromatogram. As the worms transport part of the sub-soil to the top-soil, a slight enrichment in amino-nitrogen is probably brought about.

The experiments were repeated in September which was a rainy month this year. The amino-acid contents seemed to have very much decreased in quantity and resolution of the spots was very poor, probably due to the presence of salts. A further series of investigations with more soil samples is being undertaken.

I take this opportunity of thanking Dr. P. R. Pal, Messrs. B. Mukherjee and Ajit Roy for their kind help.

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#### RES-*n*-BUTYROPHENONE OXIME AS A REAGENT FOR THE DETERMINATION OF NICKEL

EARLIER<sup>1</sup> we described the use of res-propio-phenone oxime for the determination of copper. In this note we present results of studies on the use of res-*n*-butyrophenone oxime as a reagent for the estimation of nickel.

Res-*n*-butyrophenone oxime<sup>2</sup> was obtained from res-*n*-butyrophenone by treatment with hydroxylamine hydrochloride. The oxime was crystallised from ethanol. m.p. 190° C. (lit. 188-89° C.). 1% solution of the reagent in ethanol was used for analysis.

A standard solution of nickel chloride was prepared in distilled water. The nickel content in the solution was determined by dimethylglyoxime method. The reagents used were of C. P. Grade.

A known volume of the nickel chloride solution was diluted to about 200 ml. The solution was then heated to about 80° C. and to this hot solution a slight excess of the reagent was

added dropwise with constant stirring. The solution was then made alkaline by dil. ammonia (2N). The yellowish-green precipitate of the nickel complex obtained was digested on water-bath for about an hour and filtered through sintered glass crucible. The precipitate was washed with hot water till free from the reagent and dried in an electric oven at about 110-120° C. to constant weight.

The amount of nickel in the complex was determined by the decomposition method on the basis of the formula  $\text{Ni}(\text{C}_{10}\text{H}_{12}\text{NO}_3)_2$ . Ni found by the dimethyl-glyoxime method was 13.13 while the calculated value was 13.14%.

#### RESULTS OF ANALYSIS

TABLE I

Amount of Ni, taken mg.	Wt. of Ni complex formed mg.	Amount of Ni found mg.	Difference between theor. and exptl. mg.
7.29	55.65	7.33	+0.04
21.87	166.40	21.85	-0.02
21.87	166.25	21.83	-0.04
14.58	110.10	14.46	-0.12

Error  $\pm 0.3$  per cent.

The authors are thankful to Prof. S. M. Sethna for his interest in the work and to Dr. A. M. Talati for useful discussions.

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#### LIGNANS

##### Part II\*—Synthesis of Benzophenones as Intermediates for the Synthesis of Lignans

In a recent communication, Ayres and Denney<sup>1</sup> reported the synthesis of a few benzophenones which are important as intermediates for the synthesis of lignans. We have also been working in this field and in view of the above publication, an interim report of our findings seems called for.

3, 4'-Dimethoxy-3', 4-dihydroxybenzophenone, which is an intermediate for the synthesis of the lignans-isoolivil and conidendrin was synthesised by the condensation of isovanillic acid with guaiacol using polyphosphoric acid, m.p. 178°; yield: 35% (Found: C, 65.5%; H, 5.3%;  $\text{C}_{15}\text{H}_{14}\text{O}_5$  requires: C, 65.7%; H, 5.1%); 2, 4-dinitrophenylhydrazones, m.p. 243°. (Found: N, 12.1%,  $\text{C}_{21}\text{H}_{18}\text{N}_4\text{O}_8$

requires: N, 12.3%); dimethyl ether, m.p. 145° (Found: C, 67.7%; H, 5.9%. Calc. for  $\text{C}_{17}\text{H}_{18}\text{O}_5$ : C, 67.5%; H, 5.96%). A better yield (50%) of the benzophenone was obtained when the condensation was carried out with phosphorus-oxychloride and zinc chloride.<sup>2</sup>

3, 3', 4, 4'-Tetramethoxybenzophenone which is an intermediate for the synthesis of galbulin was synthesised earlier by Kostanecki and Tambor<sup>3</sup> in 40% yield. However, the same benzophenone was obtained in a better yield (98%) by the condensation of veratric acid with veratrol in polyphosphoric acid, m.p. 145°. A mixed melting point with an authentic sample showed no depression.

3, 4, 5, 3', 4'-Pentamethoxybenzophenone, an intermediate for the synthesis of sikkimotoxin was synthesised earlier by Kostanecki and Tombor<sup>3</sup> and recently by Ayres and Denney.<sup>1</sup> The same benzophenone was obtained by us in 95% yield by condensing trimethylgallic acid with veratrol in polyphosphoric acid, m.p. 120°. (Found: C, 65.4%; H, 6.4%. Calc. for  $\text{C}_{18}\text{H}_{20}\text{O}_6$ : C, 65.1%; H, 6.1%.)

3, 4-Methylenedioxy-3', 4'-dimethoxybenzophenone which is an intermediate for the synthesis of galactin was synthesised earlier by Perkin and Weizmann.<sup>4</sup> The same benzophenone has been synthesised by us by the condensation of pipronylic acid with veratrol using polyphosphoric acid, m.p. 165°. (Found: C, 67.3%; H, 5.0%. Calc. for  $\text{C}_{16}\text{H}_{14}\text{O}_5$ : C, 67.1%; H, 4.9%); 2, 4-dinitrophenylhydrazones, m.p. 241°. (Found: N, 12.1%.  $\text{C}_{22}\text{H}_{18}\text{N}_4\text{O}_8$  requires: N, 12.0%.)

3, 4, 4'-Trimethoxybenzophenone which has been synthesised by Kostanecki and Tambor<sup>3</sup> was obtained in a much better yield (98%) by the condensation of anisic acid with veratrol in polyphosphoric acid, m.p. 100°. (Found: C, 70.6%; H, 5.6%. Calc. for  $\text{C}_{16}\text{H}_{16}\text{O}_4$ : C, 70.6%; H, 5.6%.)

3, 4'-Dimethoxy-4-hydroxybenzophenone was synthesised by Ayres and Denney<sup>1</sup> by the condensation of vanillic acid with anisole. The same benzophenone was synthesised by us by condensing anisic acid with guaiacol in polyphosphoric acid, m.p. 114°; yield 44% (Found: C, 69.3%; H, 5.4%.  $\text{C}_{15}\text{H}_{14}\text{O}_4$  requires C, 69.7%; H, 5.4%); 2, 4-dinitrophenylhydrazones, m.p. 233°. (Found: N, 12.8%;  $\text{C}_{21}\text{H}_{18}\text{N}_4\text{O}_7$  requires: N, 12.8%); methyl ether, m.p. 100°. A mixed melting point with an authentic sample showed no depression.

A few more benzophenones of this group are being synthesised and a detailed communication will appear elsewhere.

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Bombay-1, January 20, 1962. A. B. KULKARNI.

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### CALCIUM METABOLISM OF TEA

CALCIUM oxalate occurs as visible deposits in the phloem parenchyma of the tea plant (*Camellia sinensis*, L.). Visible deposits are not necessarily the only calcium oxalate, but the cells in which they occur have special meaning. A standard count of crystal-cells, described as "phloem index", has been shown to have a simple inheritance.<sup>1</sup> The cells are associated with nutrient uptake<sup>2,3</sup> and mineral content<sup>4</sup>; with the diameter of the bush and its crop yield<sup>5</sup>; with the ratio of glossy to matt bushes in a population<sup>5</sup>; and with the resistance of a clone to red-spider.<sup>6</sup> Further work has shown that the viability of tea pollen can be correlated with phloem index.

Tea pollen germinates in distilled water. The germination associated with a single flower was estimated by tapping an inverted flower on a hollow glass slide. The pollen which remained on the slide was irrigated with 0.05 ml. distilled water, and protected by a cover glass. The prepared slides were kept over water in a desiccator at room temperature (about 16° C.). After 20 hours, the total number of grains and the number of germinated grains, in the field of the microscope, was counted, using a 16 mm. objective and a  $\times 10$  ocular. Two positions on a slide were examined in this way.

The flowers had previously been bagged, and were collected at 3 p.m. about 6 hours after anthesis, in December 1958. Pollen germination was determined for three flowers per plant, in two series of plants, one series with matt leaves and the other with glossy leaves (Table I). The plants were distributed over 13 "jat" (cultivar) populations. The phloem indices of the plants had been determined from time-to-time in the past, and were abstracted from existing records.

Analysis of variance showed that the number of pollen grains obtained from an average flower differed significantly between plants in

either series at the 0.01 level. Analysis of covariance showed that the proportion of germinated grains also differed significantly between plants—in the glossy series at the 0.001 level, and in the matt series at the 0.01 level.

TABLE I

Relation of pollen germination (col. 4) to phloem index (col. 5). Plants 1-10 with glossy leaves. Plants 11-19 with matt leaves. Col. 3 gives estimate of pollen output per flower

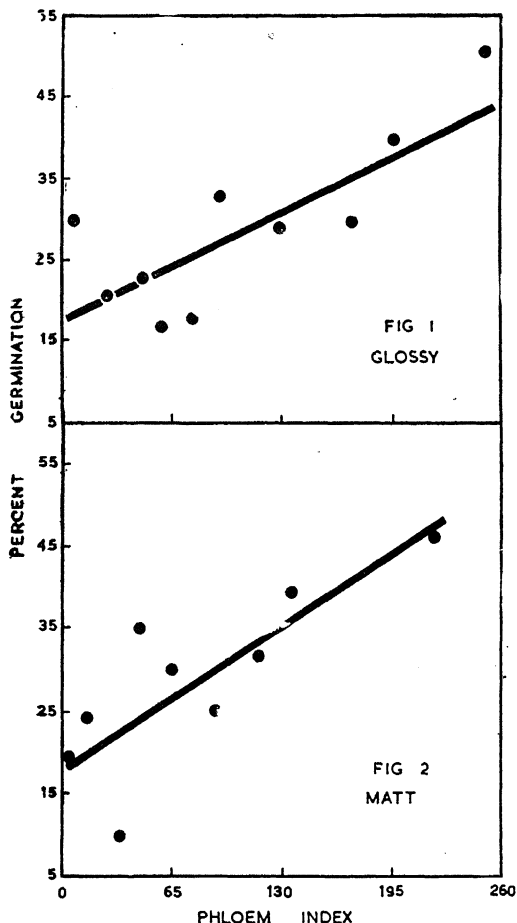
Jat population	Serial No. of plant	Mean No. of grains per count	Per cent. germinated grains	Phloem index of plant
A	1	118	30	5
B	2	70	21	27
C	3	91	23	48
D	4	127	17	59
D	5	119	18	77
E	6	75	35	92
F	7	68	29	128
G	8	90	30	173
H	9	66	40	197
I	10	58	51	252
J	11	96	19	0.3
J	12	81	24	15
J	13	149	10	35
J	14	108	35	45
K	15	89	30	64
K	16	94	25	90
K	17	85	32	115
L	18	84	39	135
M	19	66	46	220

The percentage of germinated grains was correlated with the phloem indices previously recorded. The correlation coefficients for matt and glossy series respectively were 0.80 and 0.79, both significant at the 0.01 level. The data are shown graphically in Figs. 1 and 2. The slopes of the regressions do not differ significantly, neither do their "a" intercepts. The integrated correlation coefficient is 0.80 ( $P < .001$ ).

An average pollen grain represents an average chromosome of the plant in which the pollen originates, or the genome of the plant without its allelic interactions. The correlation of pollen germination with phloem index shows that forces latent in the pollen, and expressed as growth of pollen tubes in distilled water, are correlated with deposits of calcium in the soma from which the pollen is taken. But the forces in the pollen could probably be equated with forces in the genome which caused the deposits of calcium in the soma, on the hypothesis that a common cause resides in the chromosomes.

In other plants, calcium in the pollen can determine its germination,<sup>7</sup> and it might do so in tea. It is suggested, for tea, that the number

of parenchyma cells which 'break down' and becomes masses of calcium crystals, might be proportional to a frequency of calcium ions in an average chromosome. The ions might link segments of nucleoprotein, like the calcium ions in sperm head chromosomes,<sup>8</sup> and the energetics of the chromosomes might depend on calcium ions. The mobility of less tightly bound calcium could be expected to limit the magnitude of the crystal deposits, and might also influence the behaviour of the chromosomes and gametes.



FIGS. 1-2. Per cent germination of pollen grains of tea plotted against the phloem index of the plant from which the pollen was taken.

If calcium ions in a chromosome were regularly related to aggregates of genes, and at the same time determined the crystal deposits, correlations between crystal deposits and morphological and physiological features of the tea plant would be understandable. Other explanations are, of course, possible, but the

theory now advanced suggests that calcium itself has a genetic function.

I am indebted to Mr. P. K. Barua for the estimates of pollen germination, to Messrs. K. N. Dutta and L. R. Saikia for the statistical computation, and to Mr. N. G. Gokhale, Director of Tocklai, for permission to publish.

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#### A STUDY ON THE PROBABLE RELATIONSHIP BETWEEN SEED- BORNE FUNGI AND POOR VIABILITY OF *RAUVOLFIA SERPENTINA* SEEDS

GERMINATION of seeds of *Rauvolfia serpentina* Benth. is generally poor, often not more than 10% (Santapau, 1956). Its actual cause has not so far been definitely established. The present study was undertaken to find out if there was any relation between the seed-borne fungi and germination and whether the germination could be improved by pretreatment of seeds with a fungicide.

Seeds harvested monthly from October 1959 to January 1960 were tested for the presence of internally borne fungi. Samples from each month's harvest were separated into two lots, heavy and light seeds, by dipping the samples in 10% common salt solution. Those floating on the surface were taken as light and the rest as heavy. Five hundred seeds of each lot were surface-sterilised, plated in sterilised 2% malt extract agar and incubated at 30° C. Fungal colonies developing from individual seeds were examined and counted.

It was observed that 83% of seeds harvested in the month of October showed fungal growth, consisting of species of *Fusarium* 25%, *Mucor* and *Rhizopus* 17%, *Curvularia* 8%, *Penicillium* and *Aspergillus* 7.5%, *Alternaria* 5% and unidentified fungi 20.5%. Only 7% of the seeds harvested in November showed fungal growth and those harvested in December and January were practically free. There was no difference between heavy and light seeds from the same month's harvest, as regards percentage showing

fungal growth or the types of fungi found in the seeds.

Germination tests were carried out during May-June, 1960, in normal field soil contained in petriplates. The treatments consisted of heavy-treated, heavy-untreated, light-treated and light-untreated seeds from each month's harvest from October 1959 to January 1960. Ceresan at 1:400 by weight of seed was used for treatment of seeds. For each treatment 500 seeds were sown in fifty petriplates at 10 seeds each. The experiment was repeated in May-June, 1961, with seeds harvested in October 1960 to January 1961. The data were statistically analysed. Two summary tables of pooled analysis for two years' data are given in Tables I and II.

TABLE I

Summary table of pooled analysis showing mean percentage of germination of *Rauvolfia serpentina* seeds (light and heavy, treated and untreated) during different months.

	Oct.	Nov.	Dec.	Jan.	Mean
Light	.. 12.5	49.2	34.2	20.2	29.0
Heavy	.. 47.4	73.2	75.4	58.8	63.7
Mean	.. 30.0	61.2	54.8	39.5	..
Treated	.. 27.8	61.2	64.2	39.2	48.1
Untreated	.. 32.1	61.2	45.4	39.8	44.6

(i) SE for the difference of any two means in the body of the table	=4.65
C.D. (5%)	=9.25
(ii) SE for the difference of any two marginal means of months	=3.29
C.D. (5%)	=6.55
(iii) SE for the difference of Light vs. Heavy or Treated vs. Untreated marginal means	=2.32
C.D. (5%)	=4.62

TABLE II

Summary table of pooled analysis showing percentage of germination of *Rauvolfia serpentina* seed (light and heavy, treated and untreated) taken as a mean of four months

	Treated	Untreated	Mean
Light	.. 33.4	24.7	29.1
Heavy	.. 62.8	64.6	63.7
Mean	.. 48.1	44.6	..

SE for the difference of any two means in the body of the table =3.29

It may be seen from the data that as expected, germination of heavy seeds was much better than light seeds; seeds harvested in November and December gave better germination than those harvested in October and January; pre-

treatment of seeds with a fungicide improved the germination of light seeds but had no appreciable effect on heavy seeds.

The results of the present study would indicate that probably fungi are not responsible or only partly responsible for the generally poor germination of *Rauvolfia serpentina* seeds.

The writers are grateful to Shri B. S. Gill, Assistant Statistician, Institute of Agricultural Research Statistics, New Delhi, for his kind help in statistical interpretation of the data, and to Dr. I. C. Chopra, Deputy Director, Regional Research Laboratory, Jammu, for his keen interest and encouragement.

Regional Research Laboratory, V. R. PANDOTRA.  
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## GROUNDNUT-CAKE AND RICE BRAN AS POSSIBLE SUPPLEMENTS IN THE PRODUCTION OF STREPTOMYCIN

In an earlier study,<sup>1</sup> it was shown that several pulses of indigenous origin were useful as supplements in the production of streptomycin. Similar studies on the value of groundnut oil-cake and rice bran were undertaken to determine whether these two supplements could likewise be effective in enhancing streptomycin yields. The strains of *Streptomyces griseus* and the general methods used in the present investigation were similar to those described earlier.<sup>1</sup>

In initial experiments, the following supplements were tested, each at a dry weight concentration of 0.5% per ml. of Dulane's medium: 2 groundnut-cake (non-defatted and defatted); rice bran powder, acid hydrolysate of rice bran (defatted and non-defatted). Mycelial weight, pH, spore count and streptomycin yields were determined after six days growth at 28-29°C., as preliminary studies with and without supplements had indicated that streptomycin yields were highest after this period.<sup>2</sup> The results obtained with the supplements are presented in Table I. With groundnut-cake powder as the supplement, an increase in streptomycin yield of the order of 4 to 6 times was obtained with both strains. Defatting of the oilcake reduced antibiotic yields. Rice bran powder was equally effective for strain B-150 but required to be defatted to be effective for strain MA-13. Acid hydrolysates of both the oilcake and bran were of no value and, in fact, reduced yields in most instances. The hydrolysate of rice bran,

TABLE I

Effect of groundnut-cake and rice bran supplements (0.5% W/V) on growth, sporulation and streptomycin production by *S. griseus*  
(Fermentation period, 6 days; Temperature, 29° C.)

Observations	Strains of <i>S. griseus</i>	Groundnut-cake				Rice Bran			
		Powder		Hydrolysate		Powder		Hydrolysate	
		Non-defatted	Defatted	Non-defatted	Defatted	Non-defatted	Defatted	Non-defatted	Defatted
Mycelial Wt. (mg./50 ml.)	MA-13	141.0	165.0	192.0	192.0	97.0	67.5	104.0	109.0
	NRRL-B-150	198.0	278.2	125.0	159.0	247.0	52.0	105.0	84.0
Increase in Streptomycin Yield*	MA-13	4.2	3.87	0.4	1.12	1.0	4.62	0.25	0.9
	NRRL-B-150	6.6	3.5	1.1	0.25	4.0	2.12	0.25	0.25
pH	MA-13	6.3	6.8	6.1	6.3	6.6	6.1	6.1	6.0
	NRRL-B-150	6.3	6.5	6.1	6.1	6.1	6.1	5.8	6.0
Average spore count per field†	MA-13	2	3	2	2	3	2	0	0
	NRRL-B-150	2	2	2	1	2	2	0	0

\* Expressed as the multiple of the yield secured in the Basal medium; † 0—No spores; 1—1–50 spores; 2—50–500 spores; 3—500–1,500 spores; 4—>1,500 spores.

in addition, also totally inhibited sporulation of these two strains.

Further experiments sought to determine the optimum concentration of the supplements (powders) required. With both supplements and for both strains a concentration of 0.7% (W/V) produced the highest yields of the antibiotic, yields declining at higher concentrations. Though streptomycin production was as a rule accompanied by good growth and reasonable sporulation, as in the case of pulse supplements,<sup>1</sup> no consistent relationship was detected between streptomycin yield on the one hand and mycelial weight, pH and spore count on the other.

We would like to thank Dr. R. C. Patel and Mr. I. B. Bengali for providing us with the groundnut-cake and the rice bran utilized in this study.

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## SOIL TRANSMISSION OF THE COCONUT WILT VIRUS

DURING the course of studies on the methods of transmission of the Coconut Wilt Virus (CWV),<sup>1,2</sup> it was found that this is also soil-borne. The following is a preliminary report on the mode of soil transmission of the same.

One-week-old seedlings of cowpea, grown in steam-sterilised garden soil were used as test plants, the method of inoculation being the same as described earlier.<sup>2</sup>

In preliminary experiments seedlings of cowpea were grown in the insect-proof house in pots of soil collected from the base of diseased coconut trees. Within three weeks of sowing, 35 to 40% of seedlings developed typical symptoms of 'vein clearing' and malformation of first trifoliate leaf while all seedlings grown in sterilised garden soil were healthy.

Subsequent experiments where preparations from silt and clay fractions of this infested soil were mechanically inoculated on cowpea confirmed that the virus is soil-borne. Samples of air-dried soil, passed through a 2.0 mm. sieve, were suspended in distilled water overnight and then separated according to Stokes' law into different fractions sedimenting within 30 seconds to 4 minutes (silt) and within 4 minutes to 6 hours (clay). These were centrifuged for 10 minutes at 3,000 r.p.m., the

sediments were resuspended in 0.05 M phosphate buffer at pH 8 and inoculated on test plants. The results (Table I) show that the soil from the base of almost all the diseased trees are infective, the virus being retained in the silt and clay fractions probably adsorbed on the particle surface. A critical search in the fractionated samples of soil for micro-organisms which may act as vectors has proved unsuccessful so far.

TABLE I

*Infectivity of soil samples collected from the base of healthy and diseased trees*

Source of inoculum	Soil fraction	No. of samples yielding virus/No. tested	No. of cowpea infected/inoculated	Percentage infection on cowpea
Base of healthy tree	Clay	-/10	-/80	..
	Silt	-/10	-/80	..
Base of diseased tree	Clay	14/14	49/112	44
	Silt	13/14	56/104	54

The foregoing results show that CWV is comparable to the cereal mosaic viruses of Japan and tobacco necrosis virus<sup>3</sup> in the mode of retentivity in soil. This may also explain to a certain extent the slow nature of spread of the wilt disease of coconut in nature. Coconut has an extensively spreading root system (up to 20 to 22 meters) and since the virus has been found in the roots of infected palms too,<sup>4</sup> it is probable that the virus spreads by root contact through soil. Detailed studies on the mode of soil transmission of this virus and the role that soil nematodes may play in its spread are in progress and will be reported in due course.

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## PHOSPHOMONOESTERASES ACTIVITY IN HARIANA BULL SEMEN AND ITS CORRELATION WITH OTHER SEMINAL COMPONENTS

THE role of phosphomonoesterases in semen is still far from elucidated. Reid *et al.*<sup>1</sup> suggested that the level of acid phosphatases may be a valuable criterion of semen quality. The level of acid and alkaline phosphatases by themselves vary considerably in different species. In the present study the mean levels of acid and alkaline phosphatases in Haryana bull semen have been determined and correlated with other seminal components, e.g., initial fructose, percentage unstained spermatozoa, semen volume and ascorbic acid. In all 48 ejaculates from nine young Haryana bulls were analysed for their phosphatases and ascorbic acid content according to the method of King and Wootton.<sup>2</sup> Other constituents were determined by the standard techniques. The mean level of acid phosphatases in Haryana bull semen was found to be  $349.7 \pm 19.73$  and that of alkaline phosphatase  $600.9 \pm 28.37/100$  ml. of semen in King and Armstrong units. Reid *et al.*<sup>1</sup> reported an acid phosphatase level of 170 units and alkaline phosphatase of 393 units (K-A) in bull semen. White<sup>3</sup> reported an acid phosphatase level of 170 units and alkaline phosphatase of 400 units (K-A) in Bull semen. Roy *et al.*<sup>4</sup> found an acid phosphatase level of  $145 \pm 11$  and that of alkaline phosphatase of  $134 \pm 14/100$  ml. of ox semen in Bodansky unit. Gutman and Gutman<sup>5</sup> reported that in human semen the level of alkaline phosphatase is almost nil. It is generally assumed that acid phosphatase is produced in prostate gland as such the quantum of acid phosphatase in ejaculate determines the prostatic share in the seminal pool. The level of alkaline phosphatase in the plasma of bulls has been shown to decline linearly with an increased rate of spermatozoan production. In the present study there was a positive correlation (significant at 5% level) between acid phosphatase and ascorbic acid ( $r = 0.3002$ ); between ascorbic acid and initial fructose ( $r = 0.343$ ). A highly significant correlation (1% level) was observed between acid phosphatase and alkaline phosphatase ( $r = 0.435$ ). No correlation was observed between ascorbic acid and alkaline phosphatase, acid or alkaline phosphatase and sperm concentration, initial motility and semen volume. It is well known that the level of initial fructose in semen reflects the testosterone activity of male animals. A relationship between acid phosphatase and ascorbic acid and



ascorbic acid with initial fructose tend to show that these characteristics may in some way be related to male hormonal level of bulls. More detailed study is required to explain the presence of phosphomonoesterases in bovine semen.

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### PIGMENTS OF THE FLOWERS OF *MORINGA PTERYGOSPERMA*

The flowers of *Moringa pterygosperma* are considered to possess medicinal value<sup>1</sup> as stimulant, aphrodisiac, diuretic and cholagogue. Rangaswamy and Subramanian<sup>2</sup> suggested that the medicinal properties of the *Moringa* flowers could be ascribed partly to the basic constituents present in small amounts and to the inorganic salts of potassium and calcium in fair amounts. Later, Pankajamani and Seshadri<sup>3</sup> reported on the flavonoid pigments of the fresh flowers (collected during the winter season) to be quercetin and kempferol as their 3-glycosides.

Since the *Moringa* flowers are economically valuable for drumstick fruits, it was considered desirable to examine the unfertilised flowers which wither and fall in large quantities by the evening of the day for their chemical constituents and to study the seasonal variation in the nature of the pigments. In and around Pondicherry, many trees are grown and the flowers are also used by the local people for their medicinal value. We have now examined the flowers collected in the evenings of the days during July and August (fairly hot season in Pondicherry) and found the flavonoid pigments to be the 3-glycosides of rhamnetin, quercetin and kempferol.

Following the procedure adopted earlier by Seshadri and co-workers<sup>3,4</sup> in the survey of anthoxanthin pigments, the flowers were extracted with 95% alcohol by cold maceration and the concentrated extract worked up as given earlier.<sup>4</sup> The ether concentrate on paper chromatography indicated the presence of rhamnetin and kempferol. No free quercetin was indicated.

The glycosides in the aqueous alcoholic layer was subjected to the lead salt separation in the usual manner.<sup>3</sup> In the alcoholic solution from the normal lead salt fraction, the presence of the 3-glycosides of quercetin and rhamnetin (Glycoside A and B) could be easily demonstrated by the characteristic colour tests, strongly positive Pew's reaction and almost negative Hörhammer Hänsel test. By paper chromatography, their close resemblance to isoquercitrin and xanthorhamnin could be established (Table I). The mixture of aglycones (A and B) obtained after hydrolysis with 7% sulphuric acid was shown to be quercetin and rhamnetin by paper chromatography (Table I). The sugar component was identified as glucose. By fractional crystallisation using dry ethyl acetate, of the mixed acetate of the aglycones, rhamnetin tetraacetate, m.p. 180-82, was also obtained. The identity of rhamnetin obtained by deacetylation was also established by paper chromatography. The acetate fraction corresponding to quercetin was deacetylated and identity of quercetin confirmed by comparison with an authentic sample.<sup>4</sup>

TABLE I  
Paper chromatography of the pigments of  
*Moringa* flowers  
(Temp. 30-32°)

Substance	Solvent systems*					
	Vertical ascending				Circular horizontal	
	I	II	III	IV	I	V
Glycoside A	.. 0.48	0.76	0.78	..	0.75	0.79
Isoquercitrin <sup>5</sup>	.. 0.51	0.72	0.74	..	..	..
Glycoside B	.. 0.65	0.46	0.82	0.45	..	0.75
Xanthorhamnin <sup>5,6</sup>	.. 0.70	0.50	0.82	0.44	..	..
Glycoside C	.. 0.86	0.76	0.84	..	..	0.75
Kempferitin <sup>5</sup>	.. 0.82	0.79	0.86	..	..	..
Aglycone A	.. 0.39	0.79	0.41	..	0.55	0.42
Quercetin <sup>5,7</sup>	.. 0.42	0.78	0.40	..	0.54	0.40
Aglycone B	.. 0.69	0.79	0.61	..	0.86	0.56
Rhamnetin <sup>5</sup>	.. 0.71	0.80	0.60	..	..	..
Aglycone C	.. 0.80	0.90	0.50	..	0.78	0.38
Kempferol <sup>5,7</sup>	.. 0.74	0.85	0.50	..	0.78	0.37

\* I Phenol saturated with water; II *n*-butanol  
acetic acid: water = 4:1:5 v/v, upper layer; III  
Acetic acid: water = 6:4 v/v; IV Distilled water;  
V Water saturated with phenol.

In the basic lead salt fraction, a 3-glycoside of kempferol (Glycoside C) could be identified by means of colour reactions and paper chromatography, having close resemblance to kempferitin (Table I). The identity of kempferol (aglycone C) after hydrolysis of the glycoside was also proved by comparison with an authentic sample of the compound.

The total yield of the pigments was about 0.05%.

From the point of view of biogenesis<sup>8</sup> of flavonoid pigments, it is interesting to note that the flowers collected in the evening of a hotter season contain rhamnetin (7-methyl ether of quercetin) and its glycoside as major component besides k  mpferol and its glycoside, while no free quercetin could be found. It may also be pointed out that rhamnetin, reported to have bacterial, stimulant and hypotensive properties<sup>9</sup> and k  mpferol with diuretic and cathartic action<sup>9</sup> add to the medicinal value of the flowers.

We thank Prof. T. R. Seshadri for his kind interest in this work and the authentic sample of k  mpferol and Dr. S. G. Vengasarkar for encouragement.

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#### A NEW ALLOCREADIOID METACERCARIA (TREMATODA) FROM THE WOOD-BORING PELECYPOD *MARTESIA STRIATA* (L.) AT VISAKHAPATNAM HARBOUR

LITERATURE on metacercarial stages of digenetic trematodes is replete with accidental or chance infections in unusual intermediate hosts. From the standpoint of completion of the life-cycles such cases may or may not prove to be of value. Several of them appear to be rare combinations and more or less become blind terminations because the intermediate hosts carrying the metacercari   are either unfit for inclusion as articles of diet or for various other reasons incompatible with the well established patterns of life-cycles.

In the present case an unencysted metacercaria (Fig. 1) was encountered in the visceral

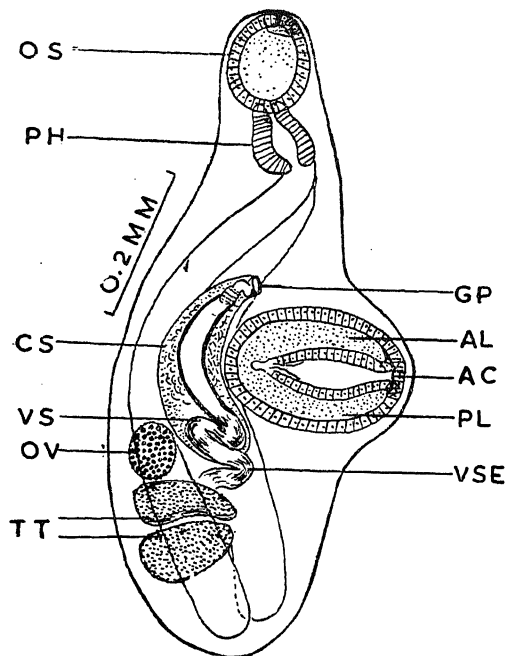


FIG. 1. Metacercaria of *Labriferoidea*, a new genus; AC, Acetabulum; AL, Anterior lamella of acetabulum; CS, Cirrus sac; GP, Genital pore; OS, Oral sucker; OV, Ovary; PH, Pharynx; PL, Posterior lamella of acetabulum; TT, Testis; VS, Vesicula seminalis interna; VSE, Vesicula seminalis externa.

mass of the wood-boring mollusc *Martesia striata* collected from jetty piles at Visakhapatnam Harbour area. The larva on releasing from the host tissues remained moderately active in sea-water for several hours. In the living state the anterior region is extensible and mobile in comparison with the posterior plump body. The body cuticle is smooth with incipient crenulations. The length of the larva is 0.825 mm. with a breadth of 0.28 mm. The subterminal oral sucker measures 0.12 mm.  $\times$  0.1 mm. The acetabulum (AC) is characteristic, presenting an oval horizontal slit at its middle with clearly defined anterior (AL) and posterior lamell   (PL) one on either side; it measures 0.175 mm.  $\times$  0.24 mm. and is situated at a distance of 0.445 mm. from the anterior end. The mouth directly leads into a conspicuous pharynx (PH) measuring 0.11 mm.  $\times$  0.083 mm. which leads into prominent intestinal c  ca reaching the posterior end. The genital pore (GP) is pre-acetabular. The male reproductive system is represented by two testes (TT) situated one behind the other in the postacetabular region.

The cirrus sac (CS) which extends posterior to the acetabulum is well developed containing a winding vesicula seminalis (VS), pars prostatica and a slightly protrusible ejaculatory duct. A short vesicula seminalis externa (VSE) could be observed. The oval ovary (OV) is pretesticular. Excretory vesicle is tubular and reaches the preacetabular region where it bifurcates. These characters suggest that the metacercaria is an allocreadiid and referable to the family Lepocreadiidae Nicoll, 1934.

Sita Anantaraman<sup>1</sup> recorded unencysted allocreadiid metacercariae from the ctenophore *Pleurobrachia globosa* Moser, 1903, from the Madras coast. However, the state of development of the larvæ encountered by her could not permit accurate allocation to any particular family although Allocreadiidae had been hinted. Judging from the unarmed cuticle, general nature of the acetabulum and internal organisation the present metacercaria more or less comes closer to the genus *Labriifer* Yamaguti, 1936, but differs in the detailed structure of the acetabulum, the postacetabular extension of the well developed cirrus sac, and the possession of a long excretory vesicle which reaches the preacetabular region. This combination of characters, together with the fact that the fluke does not resemble any of the allied described genera, would appear to warrant the erection of a new genus for which we propose the name *Labriferoides*.

Incidentally this is the first record of the occurrence of a trematode in *Martesia striata*.

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November 21, 1961.

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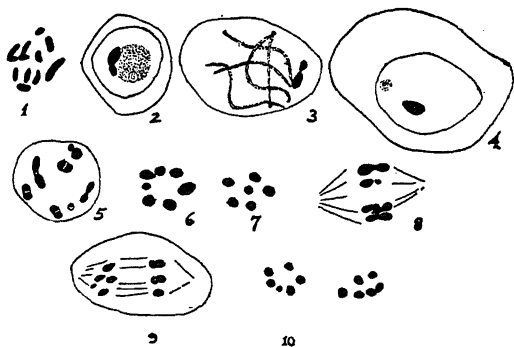
### CHROMOSOME NUMBER AND SEX MECHANISM IN *TESSARATOMA JAVANICA* (THUMB.)—PENTATOMIDAE (HETEROPTERA)

HETEROPTERA are of considerable interest to cytologists<sup>2-4,11</sup> and it is only since 1955 that Indian forms have been receiving attention.<sup>1,5-10</sup> The present communication deals with the chromosome number and sex mechanism in *Tessaratomia javanica* (Thumb.), family Pentatomidae, subfamily Tessaratominae.

The sub-adult and adult males of the species were collected from Kusum (*Schleichera trijuga*) trees grown in the plantations of the Indian Lac Research Institute, Namkum, Ranchi,

Bihar. The testes were dissected out in a physiological saline (0.7% sodium chloride solution to every 1000 ml. of which 2 ml. of 10% calcium chloride had been added) and directly transferred to the fixatives, Sanfelice and Carnoy.

The diploid number of chromosomes in the species, as revealed by the spermatogonial metaphase in polar view (Fig. 1), is twelve. They consist of one very large, one very small and ten other medium-sized elements. All the chromosomes, other than the smallest ones, are rod-shaped. The largest element is the X while the smallest chromosome is the Y.



FIGS 1-10. *Tessaratomia javanica* (Thumb.) Fig. 1. Spermatogonial metaphase (polar view). Fig. 2. Contraction stage. Fig. 3. Pachytene. Fig. 4. Diffused stage. Fig. 5. Diakinesis. Fig. 6. Metaphase I (Polar view). Fig. 7. Metaphase II (polar view). Fig. 8. Metaphase II (side view). Fig. 9. Anaphase II (side view). Fig. 10. Telophase II (polar view).

The pre-meiotic resting stage is of short duration and at leptotene the autosomal threads cross each other and occupy almost the entire nucleus. The sex-chromosomes, X and Y, lie together on one side of the nucleus as heteropycnotic, unequal bodies. A plasmosome is also clearly distinguishable within the leptotene network. This is followed by the contraction stage (Fig. 2) when the two heteropycnotic sex-chromosomes may be seen in close association and the faintly staining plasmosome lies within the contracted autosomal threads. The pachytene elements (Fig. 3) show a certain degree of polarisation. Immediately after pachytene, there is a diffuse period (Fig. 4) when the autosomal bivalents lose their stainability. The sex-chromosomes remain heteropycnotic and fused together. When the autosomal bivalence reappear they are much contracted (Fig. 5). The nucleus at diakinesis reveals five autosomal bivalents and the two sex-chromosomes.

The polar view of the first metaphase shows seven elements, which are almost spherical in

shape (Fig. 6). All the chromosomes are arranged at the periphery of the equatorial plate. The X and Y chromosomes can easily be located by their size. Meiosis I is a reduction division for the autosomes and an equational one for the sex-chromosomes.

The inter-kinetic period is of short duration as in other heteropterans. The polar view of metaphase II (Fig. 7) shows six elements, the five autosomes forming a ring, with the sex-chromosomes forming a pseudo-bivalent (Fig. 8) in the centre of the ring. The X and Y chromosomes show precocious anaphasic disjunction, each going to the opposite poles of the spindle (Figs. 9 and 10). This division, therefore, is reductional for the sex-chromosomes.

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#### A PRELIMINARY NOTE ON THE EGGS AND LARVAE OF SOME MARINE MOLLUSCS OF BOMBAY

A VALUABLE contribution to our knowledge of eggs and larvæ of marine prosobranchs was made by Natarajan (1957). Except this work in the South-east India region, no concerted attempt appears to have been made to study the eggs and larvæ of marine molluscs, particularly those of our coast-line.

While collecting animal forms from the intertidal zone at several places around the coast of Bombay, a number of eggs, ribbons and egg capsules of molluscs were found. Plankton samples also contained eggs and larvæ of molluscs. These collections were made regularly from April 1960 to April 1961. Eggs and larvæ belonging to nine species so far identified and commonly available on the Bombay coast are listed in Table I.

TABLE I

Common name	Scientific name	Structure of egg mass	Structure of free swimming stage
1 Trochus ..	<i>Trochus radiatus</i>	Loose egg ribbon, more than 300 eggs, whitish-yellow or cream	Veliger monolobed velum, glistening shell, heavy yolk cells, viscera not visible, cilia small
2 Cerithium ..	<i>Cerithium morus</i>	Loose egg ribbon, cream coloured, laid on stones or algae	Veliger yellow in colour, transparent shell, bilobed velum, foot operculum present
3 Pyrene ..	<i>Pyrene scripta</i>	Circular or oval, with plano convex upper disc, attached to sea weeds, exit hole at top, semi-transparent	Bilobed velum, transparent shell, viscera visible, foot with cilia on tip, ootocysts visible
4 Thias ..	<i>Thias bufo</i>	Eggs laid in a violet or brownish capsule, attached by stalk on rocks, exit hole on top, some mother eggs	Velum bilobed, shell pitted, eyes black, tip of the foot ciliated, dark pigment near rectum
5 Conus ..	<i>Conus monachus</i>	Clusters of capsules, yellow cream or grey stalked, top curved, exit hole on top, ridges on the sides	Large veliger small velum, small velar cilia, eyes visible, foot small, darkish pigment of viscera
6 Nerita ..	<i>Nerita oryzarum</i>	Egg capsules round or oval, strongly attached to stones, upper disc convex, 20-50 eggs, capsule calcareous	Veliger bilobed, Velum with long cilia, black eyes, reddish or brown pigment
7 do. ..	<i>Nerita alibicilia</i>	Similar to <i>Oryzarum</i> but smaller capsules, fewer eggs	Similar to <i>Oryzarum</i> but smaller, greenish pigment
8 Nudibranch (Dorid nudibranch)	<i>Doridopsis</i> species	A creamish flattened egg ribbon, coiled, honeycombed structure, eggs with eggcoat	Veliger bilobed, long velar cilia, nearly transparent shell, ootocysts seen viscera visible, midgut three divisions, foot and operculum
9 Nudibranch (Dorid nudibranch)	do.	Egg ribbon, flattened, coiled greyish yellow colour, eggs smaller than former species	Veliger bilobed, smaller in size, yolk present making shell non-transparent, two coloured spots on the shell at the base of the broad end

The identification of such eggs and larvæ was arrived at by comparing them with those laid and reared in the laboratory. In addition to the account by Natarajan (1957), those of Desai (1959), Lebour (1936), Thorson (1946), Thompson (1958), were also referred to for the identification of veliger larvæ. Details of development and illustrations will be published in due course.

I wish to express my grateful thanks to Dr. C. V. Kulkarni, Director of Fisheries, Maharashtra, and Dr. H. G. Kewalramani, Research Officer, Taraporevala Marine Biological Research Station, Bombay, for going through the manuscript. This work was carried out during my tenure as Senior Research Fellow, Council of Scientific and Industrial Research, India.

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### ROOT-KNOT EELWORM POPULATION IN A TEA SOIL AS INFLUENCED BY THE PRESENCE OF A SUSCEPTIBLE HOST PLANT

THE root-knot eelworm [*Meloidogyne incognita* (Kofoid and White) Chitwood] is an important nematode parasite capable of infesting several crop plants. In recent years, it has been noticed damaging young tea nursery plants on an appreciable scale in estates on the Nilgiris. It has several hosts, including young tea plants, but mature tea bushes are seldom seriously affected by this parasitic nematode. However, it was recently observed that under certain conditions, freshly growing feeder roots of tea bushes may be infested by this nematode, especially when such cover and green manure crops as *Tephrosia vogelii* Hook. and *Lupinus angustifolius* L. are grown in the field. It is generally realised that the presence of susceptible host plants like *Tephrosia* species tends to build up the nematode population in the soil,<sup>1,2</sup> but it is not precisely known to what extent the root-knot eelworm population is influenced by these plants. A preliminary test was made to

ascertain this and the observations are summarised here.

Soil samples were collected from the following sources: (i) the rhizosphere of infested tea and *Tephrosia* plants, and (ii) a bare patch in a tea field away from infested tea and *Tephrosia* plants, passed through a 2 mm. sieve and all root debris removed. Small earthenware pots were filled with these soils (300 g. per pot) and a control was maintained with heat sterilised soil. For each treatment 10 replicates were run. In each pot one viable seed of *L. angustifolius* was sown; this species was chosen as the indicator plant, as it is highly susceptible to the root-knot eelworm and infestation could be more readily diagnosed at an early stage of growth of the plant [Sugarcane setts are recently reported to be good indicators of infestation by *M. javanica* (Treub) Chitwood,<sup>3</sup> and this material may prove ever more useful than *L. angustifolius* for early detection of infestation by *M. incognita* also]. The lupin seedlings were examined 4 weeks after sowing the seed and the number of galls in the root system of each seedling was counted. The results are presented in Table I.

TABLE I

Treatments	Number of galls per lupin seedling	
(i) Heat sterilised soil	..	0
(ii) Tea rhizosphere soil	..	5
(iii) <i>Tephrosia</i> rhizosphere soil	..	13
(iv) Soil from bare patch	..	2

Difference required for significance at P = 0.01		2.5
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The soil sampled from the rhizosphere of *T. vogelii* supported the highest population of root-knot eelworm as indicated by the greatest number of galls developed in the root system of the indicator plant. The soil from the rhizosphere of the mature tea bush had a comparatively smaller population of the nematode. The nematode population in the bare soil was negligible and as expected no root-knot eelworm was present in the heat sterilised soil.

These results confirm that the use of such highly susceptible leguminous plants as *T. vogelii* as green manure crops leads to a significant build up of root-knot eelworm population in the soil and that it is not desirable to grow such plants in tea fields wherever root-knot eelworm is suspected. It is suggested that instead of *Tephrosia* species and lupins, *Crotalaria anagyroides* H.B.K., and other *Crotalaria* species

which are highly resistant to this parasitic nematode, may be employed, if necessary.

I am thankful to Mr. S. Ananda Rau, Chief Scientific Officer, United Planters' Association of Southern India, Coonoor, for helpful criticism of the script, and to Dr. S. Kannan, Additional Professor of Zoology, Thiagarajar College, Madurai, for the identification of the nematode.

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## INHERITANCE STUDIES IN WHEAT

### XIII. Inheritance of Field Resistance of Rio Negro and Yaqui 53 to Brown Rust of Wheat

LA PREVISION (E. 928), Frontiera (E. 957), Frondoso (E. 771), Timstein  $\times$  2086 Sel. 1495 A-1-7-3-1 (E. 871), Kenya 338. Ac. 2.E.2, 1-49-89 (E. 1951), Rio Negro (E. 952) and Yaqui 53 (Y  $\times$  E-T), 2257-15 c-1 c-5 c-1 c (E. 2842) are some of the most important genetic stocks which are under use at the Indian Agricultural Research Institute for introducing brown rust resistance into the Indian commercial wheats. The genetics of brown rust resistance using

some of these stocks, such as Frontiera Frondoso and La Prevision, have already been reported earlier (Pal, Sikka and Rao, 1956; Ghosh, Sikka and Rao, 1958 and Sikka, Rao and Ahluwalia, 1960). The inheritance studies conducted with two more wheats, viz., Rio Negro and Yaqui 53, are presented here. Incidentally the inheritance of awning and grain colour were also studied in the cross NP 718  $\times$  Yaqui 53.

The material under study consisted of the  $F_1$ ,  $F_2$ ,  $B_1$  progenies of the two crosses, N.P. 718 (S)  $\times$  Rio Negro and Yaqui 53 (R).  $F_3$  progenies were also studied in the former. Epiphytotic conditions for testing against the brown rust were artificially created and a mixture of eight races of brown rust, viz., 10, 11, 20, 26, 63, 106, 107 and 108, was released in the field both by spray and dust. Observations on rust incidence were recorded on the basis of both the type of reaction and degree of intensity of infection. The method followed for recording the rust reactions and other characters was the same as described earlier by Pal *et al.* (1956).

The  $F_1$  of both the crosses exhibited dominance of resistance for brown rust. Data on the  $F_2$ ,  $B_1$  and  $F_3$  generations of these crosses were as shown in Table I.

It would be seen from Table I that field resistance of both Rio Negro and Yaqui 53 to brown rust is governed by two pairs of dominant complementary genes, the segregation ratios in the  $F_2$  being 9 resistant : 7 susceptible. Similar results were also reported by Pal, Sikka and Rao (1956) in the cross, Frondoso (R)  $\times$  N.P.

TABLE I

Mode of inheritance of field resistance to brown rust in the  $F_2$ ,  $B_1$  and  $F_3$  progenies of the cross N.P. 718  $\times$  Rio Negro and N.P. 718  $\times$  Yaqui 53

Generation	Observed number of F <sub>2</sub> plants/F <sub>3</sub> families				Total	X <sup>2</sup>	P. value
	Resistance	Segregating		Susceptible			
		9R : 7S	3R : 1S				

(i) Cross : N.P. 718 × Kio Negro							
F <sub>2</sub> Obs.	..	406	..	..	327	733	..
Exp. (9R : 7S)	..	412.3	..	..	320.7	..	0.2207
B <sub>1</sub> Obs.	..	31	..	..	68	99	..
Exp. (1R : 3S)	..	24.75	..	..	74.25	..	2.1043
F <sub>3</sub> Obs.	..	47	17	14	34	72	..
Exp. (1 : 4 : 4 : 7)	..	45	18	18	31.5	..	2.5316
(ii) Cross : N.P. 718 × Yaqui 53							
F <sub>2</sub> Obs.	..	248	..	..	226	474	..
Exp. (9R : 7S)	..	266.7	..	..	207.3	..	2.9618
B <sub>1</sub> Obs.	..	12	..	..	55	67	..
(1R : 3S)	..	16.75	..	..	50.25	..	1.7960

789 (S), in India and by Swenson, Buchholtz and Grafius (1947) and Nyquist (1957) abroad. Frontiera and La Prevision, on the other hand, carried one and two recessive genes, respectively, for field resistance to brown rust (Sikka, Rao and Ahluwalia, 1960, and Ghosh, Sikka and Rao, 1958).

The tip-awned condition and red grain colour of Yaqui 53 were each observed to be governed by single dominant genes. The factors controlling the field reaction to brown rust were inherited independently of the factors governing awning and grain colour. The factors for grain colour and awning also did not show any association between themselves. Similar independent inheritance of these characters was also reported earlier by Ghosh, Sikka and Rao (1958), Sikka, Rao and Ahluwalia (1960) and Sikka, Jain and Parmar (1961).

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### POLYPLOIDY IN PENNISETUM ORIENTALE RICH

*Pennisetum orientale*, a grass of recognized forage value, is restricted in its natural habitat to the mid-altitudes (4,000–9,000') of the Himalayas in India. During a recent survey of this altitudinal range in the vicinity of Simla and Naini Tal, by two of us (B. D. P. and K. F. O.) a number of clones showing distinct size variations of plant parts were collected. Cyto-morphological observations recorded in this laboratory revealed that the material could be classified into four groups as shown in Table I.

It would be seen that the clones form a polyploid series, the 18-chromosome form being diploid, the 36-chromosome tetraploid and the other two, aneuploids. This constitutes the first record of the diploid, the near-diploid, and the near tetraploid, aneuploid chromosome numbers in this species. The 36-chromosome form was first reported by Hrishii (1952)<sup>1</sup> in which only an occasional quadrivalent was detected during meiosis. In the present tetraploid form, the mean frequency of quadrivalents per cell was

TABLE I  
Cyto-morphological differences in *Pennisetum orientale*

Sl. No.	Characters	Karyotypic races	Clones with somatic (2n) chromosome numbers			
			18	22	34	36
1	2		3	4	5	6
1	Chromosome Association at MI per cell					
	IV Mean	.. ..	0.39	0.96	1.66	
	Range	.. ..	(0-2)	(0-3)	(0-6)	
	III Mean	.. ..	0.28	0.20	0.07	
	Range	.. ..	(0-2)	(0-2)	(0-2)	
	II Mean	.. 9	9.4	14.28	13.88	
	Range	.. 9	(7-11)	(10-17)	(6-18)	
	I Mean	.. ..	0.92	1.0	1.38	
	Range	.. ..	(0-4)	(0-4)	(0-4)	
2	Height of culms	..	36.5	70.5	95.2	242.5
3	Tillers/season	..	20	29	37	90
4	Internode:					
	Length	..	5.22	5.86	10.55	10.55
	Diameter	..	0.14	0.19	0.25	0.34
	Nodal Fuzziness	..	+	++	++	+++
5	Leaf:					
	Length	..	17.77	27.87	27.47	37.82
	Breadth	..	0.47	0.56	0.57	1.10
6	Spike:					
	Length	..	9.77	14.27	18.52	27.39
	Breadth	..	2.37	2.08	4.57	3.26
7	Involucel density per cm. of spike	..	4.8	3.8	3.5	6.6
8	Involucel:					
	Length	..	1.14	1.66	2.28	1.62
	Breadth	..	0.50	0.50	1.35	0.67
9	Pollen Fertility (%)	..	94.2	86.6	43.1	48.1

\* Height, length, breadth and diameter are expressed in cm.

rather low, but in one cell as many as 6 quadrivalents were noticed. Moreover, the tetraploid showed a strikingly gigas habit, as compared to the diploid and it had reduced pollen fertility. No other features seemed to distinguish the two groups. The tetraploid race appears to be of autopolyploid origin in nature, although the alternative possibility of segmental allopolyploid origin through hybridization of two morphologically similar diploids showing some structural differences in their chromosomes cannot strictly be ruled out. The aneuploids seem to be hyperdiploid and hypo-tetraploid segregates from the sexual progeny of a spontaneous triploid hybrid. The 27-chromosome form of *P. orientale* studied by Narayan (1951)<sup>2</sup> may be representing the triploid hybrid. A cross of tetraploid and diploid forms is being attempted with a view to investigating the precise mode of origin of the aneuploids.

The highest number for somatic chromosomes so far reported in the species is 45 (Krishna-

swamy, 1940).<sup>3</sup> Mating of an unreduced 27-chromosome gamete of the triploid with a reduced gamete of the tetraploid is likely to give rise to such a pentaploid zygote. Thus, diploid, triploid, tetraploid, pentaploid and certain aneuploids seem to exist in the taxon, *P. orientale*. Seed progeny of the diploid showed relatively greater variation in respect of hairiness and anthocyanin pigmentation of the seedlings. On the other hand, seed progeny of the tetraploid and aneuploids showed a high degree of homogeneity which may be due to apomictic origin of the seeds. Apomixis is of particular help in the perpetuation and stability of the aneuploids. In the natural habitat, the gigas (tetraploid) form appeared to have extended over the entire distribution range of the taxon but the diploid and the aneuploid forms were restricted to relatively higher altitudes.

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### NEW DENT MAIZE HYBRID FROM ESTABLISHED U.S. INBRED LINES

EXTENSIVE tests conducted with U.S. maize hybrids in India have shown that certain hybrids, such as US 13, North Carolina 27 and Texas 26 have given from 30% to 100% more yield than the local varieties at present under cultivation.<sup>1,2</sup> These exotic hybrids have dent grains containing a higher proportion of soft starch than the hard-grained Indian flint varieties. Even though the dent-grained hybrids are discriminated against for human consumption, yet their commercial cultivation has a bright future because of the great demand of their soft starch in pharmaceutical cosmetic confectionery and other industrial products. Moreover, in isolated pockets in Rajasthan and Bihar the farmers cultivate dent maize varieties.

The U.S. dent hybrids, viz., US 13, North Carolina 27 and Texas 26, however, could not be pushed into cultivation on account of lack of adaptation on the part of their parental inbred lines.<sup>1,2</sup> For example inbreds of North Carolina 27, viz., NC 7 and NC 13 were found to be highly susceptible to downy mildew (*Sclero-*

*spora philippinensis*) and hence could not be successfully maintained.

Later work done at the Indian Agricultural Research Institute has shown that new dent experimental hybrids can be produced from the more adapted U.S. inbred lines which can even outyield the superior U.S. hybrids. Therefore, in order to meet the demand for a dent hybrid, it may be desirable to recombine the better performing U.S. inbreds into high-yielding hybrids whose commercial production is economically feasible under Indian conditions. One such hybrid, with the pedigree (Kys  $\times$  CI 21)  $\times$  (T 325  $\times$  T 203) has been found to be particularly promising and has been described in this note.

This hybrid was tested in 1959-60 at 12 locations along with 48 other entries consisting of U.S. hybrids and local varieties as checks. It significantly outyielded the local check at 8 locations, viz., Srinagar (Kashmir), Almora and Phoolbagh (Uttar Pradesh), Pusa (Bihar), Kalimpong (West Bengal), Delhi, Ajmer (Rajasthan), and Arbhavi (Mysore); the increase over the local variety ranging from 28% at Ajmer to 145% at Almora.<sup>3</sup> On the average the hybrid yielded 5,423 lb. per acre as compared to 4,948 lb. for Texas 26 and 3,528 lb. for local variety. Thus on the basis of 12 locations, it was 53% more productive than the locals and 9% more than Texas 26.

This hybrid took on an average 65 days to silk while the local took 60 days and Texas 26 took 64 days. The other character ratings, on an average were: vigour 2.3, plant aspect 2.5, ear aspect 2.2, husk cover 2.1 and *Helminthosporium* resistance 2.1, where the scale for rating was 1 (good) to 5 (poor). It showed 2.4% lodging and 2.5% stem breakage. The ratings for Texas 26 were: vigour 2.6, plant aspect 2.8, ear aspect 2.5, husk cover 2.8, *Helminthosporium* resistance 2.0, lodging 6.7% and stem breakage 3.9%. The ratings of these characters for the local variety were: vigour 2.8, plant aspect 3.4, ear aspect 2.9, husk cover 2.4, *Helminthosporium* resistance 2.7, lodging 9.5% and stem breakage 5.0%. It is thus quite clear from the above ratings that the new dent hybrid (Kys  $\times$  CI 21)  $\times$  (T 325  $\times$  T 203) is superior to Texas 26 and locals not only in yield but also in regard to other agronomic characters. It is also suited for cultivation over a wide range in the maize belt of the country.

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### A PRELIMINARY STUDY ON RESISTANCE TO STEM-BORER (*CHILO ZONELLUS* SWINH.) INFESTATION IN SORGHUM (*SORGHUM VULGARE PERS.*)

WHILE studying a varietal collection of Sorghum it was observed that though all the varieties were usually infested by the Sorghum stem-borer (*Chilo zonellus* Swinh.) the degree of infestation varied with the variety. A study was, therefore, undertaken to investigate the probable causes, for the differences in susceptibility to stem-borer infestation. Three characters, namely, maturity as measured by the number of days taken for panicle emergence; sugar content and hydrocyanic acid (HCN) content, both the latter characters recorded just before the onset of flowering, were studied in relation to the stem-borer damage. The HCN content of the youngest leaf on a plant was determined by the method suggested by Hogg and Ahlgren (1942)<sup>1</sup> and the quantitative estimates were made with the help of a photometer (H 627, Hilger and Watts, Ltd., London). The sugar content of the central portion of the first node from bottom was recorded in brix readings using a Zeiss hand-refractometer.

A widely divergent collection of seventy varieties, both indigenous and exotic, was grown in randomised blocks with four replications and observations were recorded on three randomly chosen plants of a variety in each replicate. All the individual plants, numbering about thirty, of a variety in each replication were examined at harvesting and scored in each of the five categories, mentioned below, based on visual ratings with regard to their susceptibility to stem-borer and the average rating of a variety was calculated for each replication. The five different visual scores were: 0-stem, not bored; 1-stem bored, but main shoot and panicle alive; 2-stem bored, main shoot alive but no panicle or unfilled panicle, if present; 3-stem bored, main shoot and panicle completely dead but tillers come up; 4-stem bored, main shoot and panicle completely dead resulting in a dead heart.

For determining the relationship of the three characters, namely, panicle emergence date, sugar content and HCN content with the stem-borer infestation and also their interrelationships, the phenotypic, genotypic and environmental correlation coefficients for different pairs of characters were worked out. The formula suggested by Al-Jibouri *et al.* (1958)<sup>2</sup> was adopted for computing the phenotypic and genotypic correlation coefficients while the environmental correlation coefficient was calculated by the formula proposed by Fisher (1954).<sup>3</sup>

TABLE I  
*Phenotypic (P), genotypic (G) and  
environmental (E) correlation coefficients for  
different pairs of characters*

Character		Panicle emergence	HCN content	Sugar content
HCN content	P	-0.291†	..	..
	G	-0.097	..	..
	E	0.160*	..	..
Sugar content	P	0.634†	-0.058	..
	G	0.436	-0.062	..
	E	3.305†	-0.061	..
Resistance to stem-borer	P	-0.370†	0.022	-0.385†
	G	-0.390	0.021	-0.355
	E	0.104	0.063	-0.460†

\* Significant at 5% level. † Significant at 1% level.

The stem-borer infestation showed a negative correlation with the number of days for panicle emergence and sugar content as evident from all the three types of correlations except in the case of environmental correlation which showed a positive but not significant association with the panicle emergence date. There was no association between the stem-borer infestation and HCN content but there was a positive trend in all the three types of correlations. Sugar content was positively correlated with the panicle emergence date and negatively but not significantly associated with the HCN content. The HCN content was negatively associated with panicle emergence date both phenotypically and genotypically but the environmental correlation coefficient for this pair of characters was positive.

These correlations reveal that the varieties which are late and high in sugar content are less damaged by the stem-borer than the early varieties and those having low sugar content and stem-borer attack is not related to the HCN content. Hsu (1936)<sup>4</sup> while studying the infestation of *Pyrausta nubilalis*, a stem-borer of Sorghum belonging to the same family as that of *Chilo zonellus*, observed that sorgos with high sugar content were attacked more by the borer.

However, his results do not agree with that obtained in the present investigation and this may be due to the differences in the two insect pests studied and their food habits.

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### GROWTH RESPONSE OF SOY-BEAN UNDER VARIOUS LIGHT REGIMES

THE supply of light energy can be a factor, limiting the rate of photosynthesis<sup>3</sup> and indirectly the growth of plants under natural or controlled environmental conditions. In controlled environmental conditions, it has generally been assumed that light saturation of photosynthesis occurs between 1000 to 2000 footcandles of incident white light.<sup>5</sup> It is also true that the saturating intensity might vary with species<sup>4</sup> and even within species.<sup>2</sup>

Many of these studies were concerned with various infestation of *Amaranthus hybridus* L. in soy-beans to determine yield reductions resulting from such treatments and to correlate such competition effects with the shading of crop plants by weeds. For this purpose light readings were taken with a model 603 Weston light meter in various plots where various infestations were established with planted weed species. Hawkeye soy-beans were drilled in double row plots 24 feet long and spaced 40 inches apart. Planting rate was 40 pounds per acre, resulting in a stand of approximately 10 plants per foot of row. When weeds were of sufficient size, voluntary weeds were removed and stands of planted weeds were thinned and maintained at desired levels.

Since the weed species *Amaranthus hybridus* L. grew much taller than soy-bean plants, the total light intensity was measured at the top of weeds. The other reading was recorded at top-most leaves of soy-beans to show the amount of shading due to different weed stands and the third light reading was taken at the soil surface to find out the amount of light at the ground-level. The data thus obtained, are presented in Table I in relation to average yields of soy-beans in various treatments.

TABLE I  
Yields of soybeans as influenced by shading due to various weed-infestations

Stand of <i>A. hybridus</i>	Yield of soy-beans lb./acre	Light readings in foot-candles		
		At top of <i>A. hybridus</i>	At top of soy-beans	At soil surface
Band ..	455*	6080	2560	240
1" ..	527	6120	3080	260
5" ..	689	6100	4000	300
10" ..	899	6100	4320	320
20" ..	961	6080	4520	320
40" ..	1152	6120	5560	400
Check ..	1440	..	6120	440

\* Any two means underscored by the same line are not significantly different.

The results in Table I indicate that with the decreasing weed infestations, there was a consistent increase in light intensities falling on the foliage of soy-beans and this established the fact of crop-weed competition for the amount of light required for optimum crop yields. The weed species *Amaranthus hybridus* L. germinated with soy-beans and grew rapidly enough to keep constantly above the shade canopy of soy-bean plants. Such severe yield reductions of about 65% from this type of weeds was probably due in part to shading since the weeds grew about twice the height of beans. Such competition was initiated when soy-bean was outgrown by weeds and when its foliage begins to over-shade the leaves of beans and light intensity thus available limits field photosynthesis and other assimilation phenomenon and thereby affects the growth and yield of crop plants. The same trend of results was obtained by Bakke.<sup>1</sup>

My sincere thanks are due to Prof. Fred. W. Slife, of Agronomy Department of University of Illinois, Urbana, U.S.A., for his valuable suggestions and guidance during the period of investigations 1958-61.

Agronomy Section, M. K. MOOLANI.  
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Indian Institute of Technology,  
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A NOTE ON THE NUCELLAR POLY-  
EMBRYONY IN *APHANAMIXIS*  
*POLYSTACHYA* (WALL) PARKER

THE genus *Aphanamixis* (= *Amoora*) of the family Meliaceae contains 3 species which are distributed in Bengal (Prain, 1905). The investigated species of the plant is *Aphanamixis polystachya* (= *Amoora rohituka* W and A). The plant is a medium sized tree with spreading crown of pinnate leaves and polygamous flower. The literature on the cytology and embryology of the family Meliaceae is still very fragmentary. The occurrence of polyembryony has been recorded in the genus *Azadirachta* (Garudamma, 1956).

Recently Nair (1959) during his reinvestigation on *Melia azadirach* Linn. has reported a case of polyembryony which might have been originated from one of the synergids.

During embryological investigation on the present genus *Aphanamixis*, it has been observed that some of the nucellar cells near the micropylar region in the mature ovules become richly cytoplasmic with large nuclei. These deeply cytoplasmic cells by series of divisions produce a number of embryos embedded therein the nucellar tissue (Fig. 1). It is further interesting to note that in the same preparation two large elongated mature embryos appear to hang from the nucellar tissue into the embryo-sac (Fig. 1). These two embryos probably take their origin from single individual cell of the nucellar tissue and gradually with maturation they protrude into the embryo-sac. Of the embedded embryos in the nucellus two 3-celled, one 4-celled and two somewhat globular multi-celled embryos have been noted (Fig. 1).

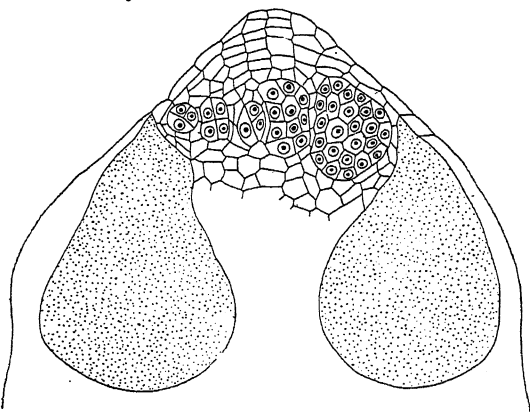


FIG. 1. L.S. of ovule through the nucellus.

It has been observed that more than 50% of the ovules examined had degenerated gametophytes. Fertilisation though occurs rarely, the

normal zygotic embryo is also produced. The occurrence of nucellar polyembryony in *Aphanamixis* takes place in 25-30% of the ovules.

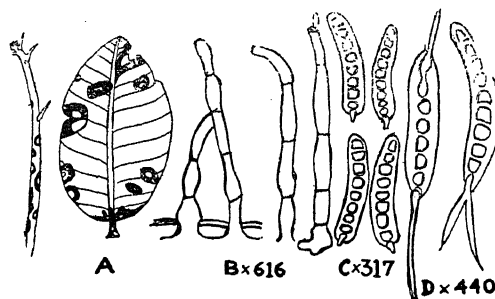
The author is indebted to Dr. I. Banerjee, the former Head of the Department of Botany, Calcutta University, for suggesting the problem and guidance, and to Dr. S. M. Sircar, the present Head of the Department for providing facilities. His thanks are also due to the Ministry of Education, Government of India, for the award of a research scholarship.

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A NEW RECORD OF HELMINTHOSPORIUM BLIGHT OF *EUPHORBIA*  
*GENICULATA* ORTEG. FROM INDIA

PLANTS of the common weed, *Euphorbia geniculata*, Ortega, were found heavily infected with a blight disease, in the campus of the Law College, Poona, during July-August 1961. The disease manifested itself in the form of rusty brown irregular necrotic areas on the leaves and spindle-shaped depressed lesions on the petioles and stems (Fig. A). The disease



FIGS. A-D

appeared to be greatly favoured by high humidity and drizzling showers. A survey made for the presence of this disease on other species of *Euphorbia* growing in the vicinity as *E. pulcherima* Wild., *E. hirata* Linn., and *E. splendens* Boj. showed that none of these species had developed any infection of the blight. Isolations made from the necrotic areas yielded a species of *Helminthosporium* Nees. (Figs. B, C and D). A careful survey of regional lists showed that there was no previous record of this disease and the fungus causing it from India.

TABLE I

Species	Conidiophores	Conidia	Authority
1 <i>H. euphorbiacearum</i> Pat. ..	110 × 13 $\mu$	120–126 × 22–25 $\mu$	Saccardo, 1892
2 <i>H. euphorbiæ</i> Hans. ..	120 × 7.0 $\mu$	50–120 × 13–18 $\mu$	Hansford, 1942–43
3 Indian species ..	125 × 7.1 $\mu$	40–130 × 14–18 $\mu$	..

Two species of *Helminthosporium* have been so far reported on species of *Euphorbia*—*H. euphorbiacearum* Pat. on *Euphorbia* species (Saccardo, 1892)<sup>1</sup> and the other *H. euphorbiæ* Hans. on *E. heterophylla* Linn. by Hansford (1942–43)<sup>2</sup> from Uganda. The Indian species was, therefore, compared with the two above species and the results obtained are given in Table I.

On the basis of comparative morphology and dimensions of conidiophores and conidia, the Indian species closely agrees with *Helminthosporium euphorbiæ* Hans. as described by Hansford (1942–43).

*Euphorbia geniculata* Orteg. is thus a new host record for *Helminthosporium euphorbiæ* Hans. and the fungus a new record for India.

The specimens are being deposited in Herb. Orientalis at New Delhi, India.

Grateful thanks are offered to Prof. M. N. Kamat for his keen interest and guidance and to the Director of this Institute for Laboratory facilities.

M.A.C.S. Laboratory, VASANT GURUNATH RAO.  
Poona-4, P. V. KELKAR.  
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### MOSAIC OF *FICUS* SPP. IN INDIA

A severe mosaic disease of fig (*Ficus palmata* Forsk.) was observed at several places in Himachal Pradesh and Punjab. The symptoms suggested the possibility of a virus being involved, which was later confirmed by experimental evidence. Studies made to establish the nature of the disease and mode of transmission are reported herein.

The symptoms of the disease on the cultivated fig varieties are the presence of yellowish-green spots scattered all over the lamina (Fig. 1B). These spots sometimes coalesce to form bigger spots of various shapes and sizes. Occasionally the leaves develop white mottling and are deformed (Fig. 1A). The leaves of wild varieties develop marked mosaic symptoms with blister-like patches and sometimes also

with oak-leaf symptoms. In advanced stages the entire leaves become pale-yellow and wither away. Diseased plants do not attain normal size and very few fruits are produced.

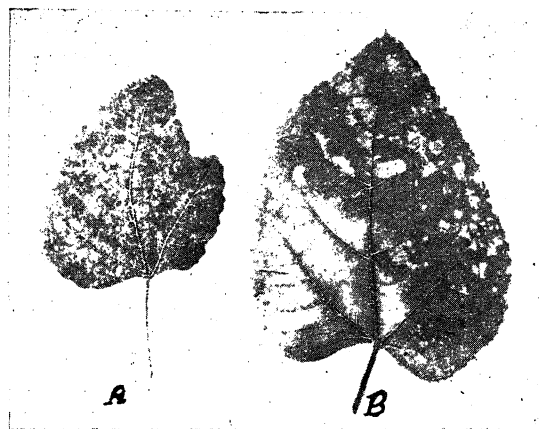


FIG. 1. (A) Mosaic mottling and deformity on *Ficus palmata*. (B) Spot mosaic on *Ficus carica*.

The disease could not be transmitted by *Myzus persicae* Sulz. and an unidentified fig aphid, or by sap inoculation to several species of *Ficus*, tobacco, bean and cucumber. Since eriophyid mites were observed on some of the diseased plants, the bud wood cuttings were either sprayed with Meta Systox, Aramite solution, or swabbed with sulphur to make them free from mites as far as possible, although these treatments seemed to reduce the percentage of successful grafts. After about 2–3 months of budding, the symptoms appeared on healthy stock seedlings grafted with buds from diseased plants but not on stocks grafted with buds from healthy plants. The plants were maintained in an insect-proof glass-house and sprayed as a routine with Meta Systox solution at weekly intervals. The host-range included *F. palmata* Forsk., *F. carica* Linn., and *F. nemoralis* Wall.

Since no organism could be isolated from the cuttings of diseased plants, and since the causal factor was infectious, it is apparent that the disease is caused by a virus. This is the only record of fig mosaic in India, although similar diseases have been reported from England (Ainsworth, 1935), U.S.A. (Condit and Horne,

1933; 1941) and Italy (Granite, 1954). The fig mosaic in Great Britain and in U.S.A. has not been shown to be transmitted by sap or through seed. The entire-leaf caprifig form of *F. palmata* Forsk. is almost immune to fig mosaic in U.S.A. (Condit and Horne, 1933), but is found susceptible to the mosaic reported herein both in nature and by artificial inoculation. Fig mosaic in U.S.A. is transmitted by an eriophyid mite, *Aceria ficus* Cotte (Flock and Wallace, 1955). Indications have been obtained that an eriophyid mite may be a vector of fig mosaic in India also, because in few cases the mites collected from diseased plants induced the mosaic on healthy seedlings but those collected from apparently healthy plants did not do so. Further studies in this direction are however, in progress.

The authors wish to express their sincere thanks to Dr. R. S. Vasudeva, Head of the Division of Mycology and Plant Pathology, I.A.R.I., New Delhi, for his keen interest and encouragement during the course of these investigations, as also to Dr. S. P. Kapoor, Virus Pathologist, for going through the manuscript.

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station, Flowerdale,  
Simla-2, October 26, 1961.

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#### THE EFFECT OF CHROMOSOME UNCOILING ON THE FREQUENCY OF BREAKS INDUCED BY MALEIC HYDRAZIDE

The effect of chromosome uncoiling on the frequency of chromosome breaks induced by mutagenic chemicals was studied using maleic hydrazide<sup>1</sup> as the mutagen and sodium bicarbonate<sup>2</sup> as the uncoiling agent. Roots of *Vicia faba* var. early bush, were immersed in a 0.12 mol. solution of sodium bicarbonate for three hours. Subsequently roots from control seedlings as well as from those soaked in  $\text{NaHCO}_3$  were treated with a 50 p.p.m. solution of maleic hydrazide for two hours. Twenty-four and forty-eight hours after the treatment, root-tips were fixed in acetic alcohol and used in making Feulgen squashes. The number and type of

chromosome breaks observed in the different treatments were scored and the data are given in Table I.

TABLE I

Treatment	Recovery period (hours)	Total cells scored	Cells with isofocus breaks	Total isofocus breaks	Chromosome exchanges	Breaks per cell
M.H.	.. 24	165	30	36	1	1.21 ± 0.010
$\text{HCO}_3 + \text{M.H.}$	.. 24	172	39	55	8	1.33 ± 0.084
M.H.	.. 48	262	68	86	17	1.31 ± 0.061
$\text{HCO}_3 + \text{M.H.}$	.. 48	268	92	136	18	1.47 ± 0.088

M.H. = Maleic Hydrazide ;  $\text{HCO}_3$  = Bicarbonate.

It is seen from the data that maleic hydrazide in combination with bicarbonate induces a higher frequency of breaks per cell as compared to maleic hydrazide alone, and this increase is statistically significant.

In *Vicia faba*, one pair (designated by the letter M) of chromosomes is longer than the rest and has median centromeres. The remaining five pairs are short and are nearly telocentric (designated by letter S). The ratio of breaks in S and M chromosomes observed in the different treatments is given in Table II.

TABLE II

Treatment	Total cells scored	Total breaks (isofocus)	Breaks in S-chromosomes	Breaks in M-chromosomes	Ratio S/M	Expected ratio
M.H.	.. 427	122	74	48	5 : 3.2	5 : 2
$\text{HCO}_3 + \text{M.H.}$	40	191	120	71	5 : 3.0	5 : 2

Since the ratio remains unaltered, it appears that the increased frequency of breaks brought about by  $\text{NaHCO}_3$  pretreatment occurs in a random manner. The observation indicates a random distribution of heterochromatin in M and S chromosomes. In the event of differential distribution of heterochromatin, the two groups of chromosomes would have responded differently to the M.H. treatment following bicarbonate uncoiling. The results of this study indicate that if total chromosome surface is increased artificially, the frequency of breaks induced by radiomimetic substances can also be increased.

I am indebted to Dr. M. S. Swaminathan for helpful suggestions, and Dr. B. P. Pal and Dr. A. B. Joshi for their interest in the study.  
Division of Botany, R. N. MUKHERJEE.  
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## REVIEWS

**Elementary Differential Equations.** Second Edition. By W. T. Martin and E. Reissner. (Addison-Wesley Publishing Company, Inc., Reading, Massachusetts and 10-15, Chitty St., London, W. 1), 1961. Price \$ 6.75.

The fact that this text-book has had a second and enlarged edition vouches for the success with which the authors have provided "the Science and Engineering student who needs to know Mathematics rather well with a useful working knowledge of the subject". The stress, of course, must be laid upon the words "useful" and "working knowledge" for Mathematics students would require a more thorough treatment.

One of the authors is a Mathematician known for his research work in Pure Mathematics; the other is an Engineer teaching Applied Mathematics in the M.I.T. Such a collaboration explains why this text differs much from many other texts written with the same purpose. On the one side there is always perfect rigour in the proofs; on the other the selection of material will allow the student to acquire a good deal of information about some of the fundamental ideas of the theory of differential equations. I point, in particular, to the Picard theorem of existence by the method of successive approximations and to the integration by series.

Lacking experience in teaching Engineering students, the reviewer wonders whether some questions might not have received more generous developments. The chapter on Finite Differences is certainly very sketchy. Some idea of partial differential equations of the hyperbolic and of the elliptic types could have been given.

The great number of examples and exercises to be found in this text-book will certainly prove most useful to the students as well as to their teachers.

C. RACINE.

**Techniques of High Energy Physics.** By Ritson (Interscience Publishers, New York, London), 1961. Pp. 540. Price \$ 16.75.

This is the fifth volume in the Interscience monographs and texts in physics and astronomy, under the general editorship of Marshak of the University of Rochester. Since World War II, the style of Instrumentation in high energy

physics has changed so fundamentally, that a young physicist starting his career in research, would be very greatly handicapped unless good books are available, written lucidly, by distinguished workers in the field. Out of the eleven chapters, in the present book, five are written by members of staff of the Massachusetts Institute of Technology, the rest by those near about or in Massachusetts. This has contributed to a real unified treatment, which, otherwise, would have been difficult. In this fast growing field, as the editor has recognized, many sections could be out of date, even before they appear in print. This fear has been occasioned by the particularly rapid strides made in the use of computers for handling data and the advent of new breeds of faster and more intelligent computers. Yet, one does not feel less bewildered even after reading the section on digital computers by Flanagan of the Business Machine Corporation, New York and Calwell of MIT. The technique of image intensifiers and spark chambers are dealt with, all too briefly in the section of scintillation and Cerenkov counters, subsection, solid scintillation chambers and hodoscopes, by Ritson and Weinstein. Appendix VI is a welcome supplement for pulsed spark counters. Old techniques, such as of Geiger counters and expansion cloud chambers, have rightly been omitted, as being obsolete. Diffusion cloud chambers by Schluter (Chapter II), bubble chambers by Plem (Chapter III), Ionization counters by Wilson (Chapter VI) have all been lucidly written. Beam optics, dealing with the determination of the nature, energy and number of particles produced or scattered when a target is bombarded by very high energy particles, is treated in Chapter IX, while the last two chapters are devoted to target preparation and beam monitoring. There is no doubt that this book is invaluable to all nuclear physicists, and to those teachers who have to keep in touch with the latest developments in physics.

B. DASANNACHARYA.

**Lectures in Theoretical Physics, Vol. III.** Edited by W. E. Brittin, B. W. Downs and J. Downs. (Interscience Publishers, New York-1, N.Y.), 1961. Pp. 531. Price \$ 11.00.

The third volume in this series contains material presented in lectures given at the third annual Summer Institute for Theoretical

Physics held in the Department of Physics of the University of Colorado from June 20 to August 25, 1960. The authors having chosen their own topics of interest have brought to bear not only expert knowledge on the subject but also a method of presentation which will be clearly understood. There is no doubt that students and researchers of physics will be profited by a close study of the book.

The contents are as follows: Causality and Dispersion Relations by A. Bohr, Selected Topics in Theoretical Physics by W. F. Weisskopf, Statistical Mechanics of Irreversibility by R. Zwanzig, The Scattering of Electrons by Atoms by B. L. Moiseiwitsch, Some Applications of the Generating Functional of the Molecular Distribution Functions by M. Green, Non-equilibrium Statistical Mechanics by E. Montroll, Quantum Theory of Collision Processes by R. Haag, Canonical Commutation Relations in Field Theory and Functional Integration by R. Haag, General Theory of Non-equilibrium Phenomena by R. Balescu, Martin-Schwinger Methods in the Many Body Problem by N. Ashby, Green's Functions and the Quantum Theory of Fields by K. Symanzik.

Dover Publications:

**A Treatise on Hydrodynamics.** By A. B. Basset.  
2 Volumes. Price \$1.75 each.

**Strength of Materials.** By J. P. Den Hartog.  
Price \$2.00.

**Mechanics.** By J. P. Den Hartog. Price \$2.00.

**Mathematics of Modern Engineering.** By Ernest G. Keller and Robert E. Doherty.  
2 Volumes. Price \$1.65 each.

**Supersonic Aerodynamics.** By E. R. C. Miles.  
Price \$1.45.

**Applied Elasticity.** By John Prescott. Price \$2.95.

**Fluid Mechanics for Hydraulic Engineers.** By Hunter Rouse. Price \$2.00.

**Mathematical Methods for Scientists and Engineers.** By Lloyd P. Smith. Price \$2.00.

Basset's *Treatise on Hydrodynamics* covers the entire theory of classical hydrodynamics with much material on the works of classical formulators as well as documentation on the results and methods of papers by such men as J. J. Thompson, A. E. H. Love, Hicks, Greenhill, G. H. Darwin, Besant, Lamb, Kirchhoff and other turn-of-the-century investigators. It is an excellent text for the beginning student and a basic reference work.

*Strength of Materials* was originally prepared by Professor Den Hartog to meet the needs of engineering students at MIT for a sound first course in strength of materials. *Mechanics*, published only a dozen years ago, has become something of a classic among introductory texts on mechanics.

*Mathematics of Modern Engineering* is directed to the contemporary engineer who draws heavily on mathematical techniques that would have been out of reach of the average engineer of a generation ago. It deals with such branches of mathematics as determinants, tensors, the Heaviside operational calculus, dyadics, the calculus of variations, etc.

Miles' *Supersonic Aerodynamics* is distinctive for its emphasis on mathematics. It prepares the advanced student for handling the mathematical tools and principles necessary for a sound understanding of theoretical aerodynamics.

Prescott's *Applied Elasticity* develops every important type of elasticity problem from theoretical principles to practical solution with just enough mathematical theory to make the development clear and easy to follow.

*Fluid Mechanics for Hydraulic Engineers* was the first book to present a coherent picture of fluid mechanics from the point of view of the hydraulic engineer. First published in 1938, it has since become a classic and one of the most frequently cited works in fluid mechanics.

Lloyd P. Smith's *Mathematical Methods for Scientists and Engineers* offers a thorough investigation of mathematical methods and a practical description of the conditions under which each method should be used. This is a very useful book for practising scientists and engineers as well as advanced students.

**Columbium Metallurgy.** Edited by D. L. Douglass and F. W. Kunz. (Interscience Publishers, New York, London.) Pp. 746. Price \$26.00.

The book under review is part of the series covering the proceedings of the 9th Metallurgical Society Conference, sponsored by the Metallurgical Society of the A.I.M.E. and it presents the 'state of the art' of columbium metallurgy and alloy development. The aircraft, the missile and the nuclear industry have created many a material problem which titanium and stainless steels cannot surmount and the logical choice falls upon the truly high temperature material, columbium even among the refractory metals. And the symposium was the consequence of the earnest realisation that

exchange of ideas, avoiding duplication, and 'fertilizing' the field were paramount.

The 746-page book contains 32 papers from well-known workers in the field in the U.S.A. and Austria and is classified under five major headings prefaced by an introduction, critically appraising the relative position of columbium as compared with other materials for missile, aircraft and nuclear application.

The first heading 'Fabrication' contains some 8 papers and discussions thereon. The contributions discuss a method of self-bonding of columbium, details of forming characteristics of five columbium alloys, workability and mechanical properties, fabrication at low temperature, influence of gaseous contaminants, oxidation resistance of aluminium dip coating, and vacuum arc melting.

Mechanical properties are next discussed in the succeeding 8 papers, the first two dealing excellently with the columbium-titanium-tungsten alloys. The use of columbium base alloys in pressurized water reactors, strain aging effects in titanium and the processing of the F-48 columbium alloy sheet are presented next. Details have also been presented on the performance at elevated temperature, the creep mechanism and the interrelation between structure and some mechanical properties.

The subject of the general metallurgy of columbium is covered by the next 8 contributions. Aspects like alloying behaviour, flow and fracture characteristics of columbium and details on some important binary systems, their thermodynamic functions, technology of some alloys, recovery and recrystallization in some alloys are discussed in some detail.

The last section styled "Oxidation and Corrosion" is covered again by another 8 papers. The first two papers discuss the oxidation and mechanical properties of columbium-aluminium-vanadium alloys. In the other papers the authors discuss steam corrosion of columbium-vanadium alloys, ignition, oxidation at low pressures, 'Break away' phenomena, hot water corrosion and the kinetics of oxidation.

The 32 papers in the book very convincingly establish that columbium is the metal of the future for high temperature applications from standpoints like availability, strength-weight ratio, and oxidation resistance, etc.

The book is profusely illustrated with diagrams, graphs, tables and photomicrographs and is a 'must' to the columbium metallurgist and the metals engineers of the aircraft, missile and nuclear industry.

A. A. KRISHNAN.

**Quantitative Organic Microanalysis**, Second Edition. By Al Steyermark. Academic Press, New York and London; India: Asia Publishing House, Bombay-1), 1961. Pp. 665. Price \$ 16.50.

The second edition of *Quantitative Organic Microanalysis* by Al Steyermark has made its appearance as a great impetus to organic analysts to adopt improved methods and techniques of analysis, to augment more efficient working of the equipments, and also to popularise the estimation of the element, oxygen, in organic laboratories. The book has been written by a well-known authority on the subject, who has not only been in the active field for more than twenty years but also is the Chairman of the committees concerned with microanalytical determination of the American Chemical Society, American Society for Testing Materials, and the International Union of Pure and Applied Chemistry, and as such it contains most reliable up-to-date developments in methods and techniques of microanalysis in great details. The book also provides a useful chapter on micro-determination of some physical constants, such as melting-point, boiling-point, specific gravity, etc., and also extensive tables of reference at the end of each chapter. D. K. BANERJI.

**Numerical Methods of Curve Fitting**. By P. G. Guest, 1961. Pp. xiv + 422. Price 80 sh.; **A Book of Curves**. By E. H. Lockwood, 1961. Pp. xi + 198. Price 25 sh. (Cambridge University Press, London, N.W. 1).

To many drawing curves is a fascinating hobby. Records are not wanting to show that many famous mathematicians and scientists altogether enjoyed playing with curves. It is said that Kepler found the planetary orbit to be an ellipse after a series of trials with a variety of curves. The importance of curves as mathematical objects cannot be overemphasised. Their value in statistical science and as aids in analysis of observational data is well known. The two publications by the Cambridge University Press, one full of curves and written at an elementary level for schools, and the other almost void of curves but replete with equations and tables and written at the college level, will be welcomed by the category of students for which each is intended.

The *Book of Curves* describes methods of drawing plane curves, beginning with conic sections and going on to cycloid curves, spirals, catenaries, conchoids, pedal curves, glissettes, caustics, and so on. The approach is by pure



geometry, starting in each case with methods of drawing the curve and guiding the interested reader to explore for himself the construction and properties of new and more fascinating curves. A delightful photograph of the Pearly Nautilus fossil appears as the frontispiece.

In *Numerical Methods of Curve Fitting* Prof. Guest gives a comprehensive account of methods for reducing sets of observations and for fitting curves to numerical data. The book is in three Parts of increasing importance, and also of increasing clarity in treatment. Part I, of about 80 pages, deals in a cursory manner with observations of a single variable. Part II, of about 60 pages, deals with the regression theory and the straight line. Part III which forms the bulk of the book is devoted to the fitting of polynomial curves and of special types of curve. A number of typical examples have been worked out in detail and these should prove useful from a practical point of view. Much of the material in this part is to be found only in original papers and the inclusion of these treatments brings them within easy access to research workers and students.

A. S. G.

**Plastic Flow and Fracture in Solids.** By T. Y. Thomas. (Academic Press, New York and London; India: Asia Publishing House, Bombay-1), 1961. Pp. x + 267. Price \$8.50.

Interest in plastic phenomena in solids has increased considerably in recent years, due to the desire and necessity to know more about the materials used in construction of structures. This book deals at a fairly advanced level with the fundamental principles involved in plastic flow leading ultimately to failure of solids from a macroscopic point of view. It is devoted mainly to the propagation, growth and decay of discontinuities in solids. Extensive use is made of the tensorial notation and concepts.

The book is divided into six chapters. The first two chapters are devoted to discuss the fundamental concepts of equilibrium and compatibility with particular reference to discontinuous surfaces. The problem of decay of waves in elastic media is treated in Chapter III. The various constitutive equations for perfectly plastic solids are presented in the fourth chapter. An interesting method of deriving an yield condition involving an arbitrary material function is presented. As applications of the theory developed, the problem of characteristic surface and wave propagation in plastic solids is treated in Chapter V.

In Chapter VI, the problem of fracture in solids is discussed. Fracture in a perfectly plastic solid is interpreted as the occurrence of a surface over which any initial slip is not damped out and, instead, the velocity of deformation becomes infinite in a finite time. This approach and interpretation are very interesting.

The book, on the whole, is a welcome addition to the growing volume of literature on plasticity and fracture and can be of great interest to every mathematically inclined engineer.

P. NARASIMHA MURTHY.

**British Flies, Vol. VI.—Empididae.** By J. E. Collin. Part II. Hybotinae and Empidinae (except *Hilara*), 1961. Pp. 223-551. Price 30 sh.; Part III. Empidinae (*Hilara* only) and Hemerodrominae. (Cambridge University Press, London, N.W. 1), 1961. Pp. 552-782. Price 30 sh.

This standard work on *British Flies* was first inaugurated by the late Mr. G. H. Verral, and Vol. VI on Empididae by Collin constitutes the third to be published in this series. The complete volume contains full descriptions of all the 354 recorded British species of the family Empididae. By comparing many of them with the original 'Types' the author has ensured a high standard of stability in their nomenclature. The volume is profusely illustrated and contains as many as 317 figures, all clearly drawn. Among the Empididae, as the male genital organs offer important generic and specific characters, many large-scale drawings of these are given.

While the whole book is available in a cloth cover, for convenience in practical use it is issued in three separate paper-covered parts with continuous pagination.

Part II deals with Hybotinae (Pp. 221-324) and Empidinae (except *Hilara*) (pp. 325-551), and Part III with *Hilara* (Pp. 555-680) and Hemerodrominae (Pp. 681-767). Part III also contains the general index for the whole volume.

This standard work is indispensable as a reference book to workers whose special field of study is *Empididae*.

**International Review of Cytology, Vol. X and XI.** Edited by G. H. Bourne and J. F. Danielli. (Academic Press, New York and London; India: Asia Publishing House, Bombay-1), 1960 and 1961. Pp. xiv + 409 and xii + 356. Price \$13.00 and \$11.00.

The authoritative nature of the contributions and the attempt at objectivity by the contributors have made the general student as well

as the specialist look forward to fresh issues of the *International Review of Cytology*. As usual, the reader gets a varied fare and some articles like the Ultrastructure of the Nucleus (Wischmitzer, Vol. X) and the Electron Microscopic Analysis of the Secretion Mechanism (Kurosumi, Vol. XI) are on topics published in the earlier volumes. The time and the author make the newer approaches refreshing.

It is not surprising, therefore, to find that the earlier analysis of the Chromosome Structure presented by Kaufmann, Gay and McDonald in Volume IX, claiming resolution into a large number of sub-chromonemata, are questioned by Wischnitzer (Vol. X). He concludes: "In general it can be stated that in so far as the elucidation of the fine structure of chromosome by electron microscopy is concerned, this new cytological technique has failed to confirm the presence of any highly organized structures" (Vol. V, p. 145).

The study of the molecular anatomy of various structures now being attempted would require radical periodic revisions and it is in this context that the *International Review of Cytology* is likely to play an increasingly active role.

M. K. SUBRAMANIAM.

**Fish as Food, Vol. I.** Edited by Georg Borgstrom. (Academic Press, New York and London), 1961. Pp. xiv + 725. Price Approx. \$ 24.00.

The subject-matter of this volume is dealt with in seventeen chapters, under the three main divisions production, biochemistry and microbiology. In writing the book the editor has succeeded in securing the co-operation of leading fishery scientists, mainly from Europe, U.S.A., Canada and Japan. Dr. Borgstrom has edited this book with the objective that this comprehensive volume of reviews will be a source of "abundant and valuable information" to a wide range of research workers.

The first five chapters on production describe respectively—biology of seafood production, world fisheries, fish cultivation in Europe, carp cultivation in Japan, and raising fish for food in south-east Asia. All the articles are ably written, especially the one on "world fisheries", even though most of the catch figures both in marine and inland fisheries do not appear to be up-to-date. One of the obvious omissions in the fifth chapter is the contribution of India in the field of fisheries. India being one of the major fish-producing countries in this region, one would expect India's contribution mentioned in this article.

In the field of biochemistry of fish, eight well-known scientists have contributed articles on—organic constituents of fish and other aquatic animal foods, biochemistry of fish oils, recent findings in fatty acid composition of marine oils, fish protein with special reference to freezing, histamine problem, non-protein nitrogenous compounds, rigor-mortis and vitamins of fish. In these chapters the contributors have discussed the composition of different types of flesh, influence of sex on the composition of fish flesh, distribution of nitrogen in fish flesh, amino-acid composition of different species of fish, general characteristics of fish lipid, composition of different types of oils, fatty acids and rancidity problems in fish, proteins with special reference to muscle-protein and changes in frozen fish-protein, non-protein nitrogenous compounds, fat-soluble and water-soluble vitamins in edible parts of fish. The importance of increasing the duration of rigor for suppressing the development of micro-organisms causing spoilage and particularly role of ATP for the onset of rigor-mortis in fish has found mention in Chapter 12.

Under the subject of microbiology are included sea-water fish, spoilage of freshwater fish, shellfish deterioration and chemical control of microbiological deterioration. At the end of each chapter there is a comprehensive list of references on the subject.

There is no doubt that the book will be of considerable interest to Fishery Technologists and Administrators.

B. S. BHIMACHAR.

**The Invertebrata.** By L. A. Borradaile and F. A. Potts. (Cambridge University Press, London, N.W. 1), 1961. Pp. xvii + 820. Price 55 sh.

This text-book of zoology has been most popular with the undergraduate and honours students for over a quarter of a century. Since its first publication in 1932, the book had gone through several reprints, and a completely revised, enlarged and reset edition appeared in 1958 as the Third Edition, with a special chapter on zoological literature added to the text. In this Fourth Edition G. A. Kerkut has made further revisions, many figures have been redrawn and the last chapter on zoological literature has been brought up-to-date. There is no doubt that this comprehensive manual of invertebrate zoology will hold its leading position among the undergraduate text-books on the subject.

Books Received

om : Dover Publication, 180, Varick Street, New York-14, N.Y. :

Applied Elasticity. By J. Prescott. Pp. 666. Price \$ 2.95.

mechanics. By J. P. Den Hartog. Pp. ix + 462. Price \$ 2.00.

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ength of Materials. By J. P. Den Hartog. Pp. 323. Price \$ 1.95.

athematics of Modern Engineering. By E. G. Keller and R. E. Doherty. Vol. I, Pp. xii + 264, Price \$ 1.75 ; Vol. II, Pp. xv + 328, Price \$ 1.75.

ersonic Aerodynamics—A Theoretical Introduction. By E. R. C. Miles. Pp. xi + 255. Price \$ 1.45.

athematical Methods for Scientists and Engineers. By L. P. Smith. Pp. x + 453. Price \$ 2.00.

ie Life of Pasteur. By R. V. Radot, 1960. Pp. xxi + 484. Price \$ 2.00.

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om : Pergamon Press Ltd., Headington Hill Hall, Oxford :

popular Lectures in Mathematics (Vols. I-VI) : Vol. I. *The Method of Mathematical Induction*. By I. S. Sominskii, 1961. Pp. vii + 57. Price 7 sh. 6 d.

Vol. II. *Fibonacci Numbers*. By N. N. Vorob'ev, 1961. Pp. viii + 66. Price 10 sh.

Vol. III. *Some Applications of Mechanics to Mathematics*. By V. A. Uspenskii, 1961. Pp. vii + 58. Price 10 sh.

Vol. IV. *Geometrical Constructions Using Compasses Only*. By A. N. Kostovskii, 1961. Pp. xi + 79. Price 10 sh.

Vol. V. *The Ruler in Geometrical Constructions*. By A. S. Smogorzhevskii, 1961. Pp. viii + 86. Price 10 sh.

Vol. VI. *Inequalities*. By P. P. Korovkin. Pp. vii + 60. Price 10 sh.

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ohn Von Neumann Collected Works (Vol. I)—*Logic. Theory of Sets and Quantum Mechanics*.

Edited by A. H. Taub, 1961. Pp. x + 654. Price £ 5.

*Six Figure Logarithms, Antilogarithms and Logarithmic Trigonometrical Functions*. By C. Attwood, 1961. Pp. 139. Price \$ 2.00.

From : Academic Press, New York and London ; India : Asia Publishing House, Bombay-1 :

*Recent Progress in Hormone Research* (Vol. XVII). Edited by G. Pincus, 1961. Pp. viii + 600. Price \$ 14.00.

*Lectures on Field Theory and the Many-Body Problem*. Edited by E. R. Caianiello, 1961. Pp. xiii + 327. Price \$ 9.50.

*The Cell* (Vol. III)—*Biochemistry, Physiology, Morphology*. Edited by J. Brachet and A. E. Mirsky, 1961. Pp. xiii + 440. Price \$ 12.00.

*Metabolic Pathways*. Edited by D. M. Greenberg, 1961. Pp. xiii + 814. Price \$ 24.00.

*Advances in Space Science and Technology* (Vol. III). Edited by F. I. Ordway, III, 1961. Pp. xiii + 482. Price \$ 14.00.

*Gyrodynamics*. By R. N. Arnold and L. Maunder, 1961. Pp. x + 484. Price £ 5.

*Methods of Experimental Physics* (Vol. V)—*Nuclear Physics* (Part A). Edited by L. C. L. Yuan, Chien-Shung Wu, 1961. Pp. xix + 733. Price \$ 18.00.

*Mathematics in Science and Engineering* (Vol. IV)—*Stability by Liapunov's Direct Method with Applications*. By J. L. Salle and S. Lefschetz, 1961. Pp. vii + 124. Price \$5.50.

*The Chemistry of Heterocyclic Compounds*. By C. M. Badger, 1961. Pp. ix + 498. Price \$ 12.00.

*General Cytochemical Methods* (Vol. II). Edited by J. F. Danielli, 1961. Pp. xi + 297. Price \$ 10.00.

*The Action of Insulin on Cells*. By M. E. Krahl, 1961. Pp. ix + 202. Price \$ 7.50.

*Advances in Applied Mechanics* (Supplement I)—*Rarefied Gas Dynamics*. Edited by L. Talbot, 1961. Pp. xv + 748. Price \$ 19.00.

*Advances in Genetics* (Vol. X). Edited by E. W. Caspari and J. M. Thoday, 1961. Pp. ix + 429. Price \$ 10.00.

*Polyelectrolyte Solutions—A Theoretical Introduction*. By S. A. Rice and M. Nagasawa, 1961. Pp. xv + 568. Price \$ 16.50.

*Advances in Clinical Chemistry* (Vol. IV). Edited by Harry Sobotka and C. P. Stewart, 1961. Pp. xiv + 378. Price \$ 12.00.

*Introduction to Hypersonic Flow*. By G. G. Chernyi. Translated by Ronald F. Probstein, 1961. Pp. xiv + 262. Price \$ 8.00.

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## SCIENCE NOTES AND NEWS

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### International Conference on 'the Ionosphere'

The Institute of Physics and the Physical Society announces that it is arranging a conference on "The Ionosphere" to take place at the Imperial College of Science and Technology, London, from 2 to 6 July, 1962. The Conference is to cover four wide fields, namely, Ionospheric constitution and ionizing radiations, Geomagnetism and the ionosphere, Irregularities and drifts in the ionosphere, Mathematics of wave propagation through the ionosphere. Further particulars and reply forms are available from the Administration Assistant, The Institute of Physics and The Physical Society, 47, Belgrave Square, London S.W. 1.

The date of the Conference on "Low Energy Nuclear Physics" has been changed from 10 to 12 September to 12 to 14 September, 1962.

### The International Camellia Society

The International Camellia Society which was inaugurated on April 1st, 1962, is the first international society to be devoted to a single genus of plants.

Among the objects of the Camellia Society are: Undertaking historical, scientific and horticultural research in connection with camellias and dissemination of information concerning camellias by means of bulletins and other publications.

The First Board of the Society consists of Prof. E. G. Waterhouse, O.B.E., Australia, President; Mr. A. Fendig, U.S.A., Vice-President; and ten directors representing the chief camellia areas of the world.

Membership is open to all, amateur and professional. Annual subscription—One Pound Sterling or equivalent in other currencies. Life-Membership—Twenty Pounds Sterling or equivalent in other currencies.

All communications and subscriptions to be sent to the Secretary, Charles Puddle, Bodnant Gardens, Tal-y-cafn, Colwyn Bay, Denbighshire, United Kingdom.

### Symposium on Problems of Man in Space

An International symposium on "Basic Environmental Problems of Man in Space" to be held in Paris from October 29 to November 2, 1962, is being organised jointly by the International Astronautical Federation and the Inter-

national Academy of Astronautics, with the support and co-operation of Unesco, the International Atomic Energy Agency, and the World Health Organization.

The Programme of the five-day symposium will be devoted to three main problems: ecophysiology; psychophysiology, and data acquisition, analysis and control. One session of the symposium will be devoted to review papers of a more general nature.

Plans have also been made for an exhibition showing techniques used to study problems encountered by man during flight in space, and equipment which has so far been developed for survival in space, such as cabins and suits.

### The Indian Pharmaceutical Congress Association

The following Office-bearers have been elected to the Indian Pharmaceutical Congress Association for 1962: President: Mr. B. V. Patel, Director, Drug Control Administration, Ahmedabad; Hon. Gen. Secy.: Dr. Diptish Chakravarty, Smith Stainstreet & Co. Ltd., Calcutta; Hon. Foreign Secy: Dr. P. L. Seth of Calcutta; Hon. Treasurer: Sri. S. K. Mukherjee of Calcutta.

The Fifteenth Session of the Congress will be held at Pilani, Rajasthan, during December 28 to 30, 1962. Further particulars can be had from Dr. D. Chakravarty, Hon. Gen. Secy., Indian Pharmaceutical Congress Association, 14, Ganesh Chandra Avenue, Calcutta-13.

### International Society for Tropical Ecology

We have been informed by the Honorary Treasurer that the Office of the International Society for Tropical Ecology has shifted from Allahabad to Varanasi (India). Requests for membership forms and Society's Publications should be sent to the Honorary Treasurer, Department of Botany, Banaras Hindu University, Varanasi (India).

### Performance of Veneer Grafting in Comparison to Other Methods of Propagation in Mango

Messrs. S. K. Mukherjee and P. K. Majumder, Division of Horticulture, Indian Agricultural Research Institute, New Delhi, write: Although budding and other methods have proved successful in research stations, inarching though laborious and costly is still practised widely by most nurserymen in India. Veneer grafting has

been tried to find out whether it can replace inarching.

Veneer grafting and budding were tried on 25 seedlings, one year old in nursery beds, in each of the varieties Langra, Dashehari and Chousa during July, September and October of 1961. The success of veneer grafting in July was about 80% in all the varieties, but budding gave a maximum take of 20% ; in September, it was 92, 44 and 20% in Langra, Chousa and Dashehari respectively against only 4% by budding ; in October, 25-50% against no take by budding. It was also observed that the growth of scion shoots in length and number of branches were very similar to inarching, whereas in the budding the growth was very little (in 4 months). It indicates that veneer grafting is superior to budding as regards commercial adaptability and is at par with inarching. It is superior to inarching as detached scion shoots can be used.

#### The First American Manned Earth-Satellite

On February 20, 1962 the United States successfully launched her first manned-satellite to orbit round the earth. The astronaut was Lt.-Col. John Glenn of the U.S. Marines. The satellite which weighed 1350 kg. was projected into an orbit inclined at  $32.5^\circ$  to the equator. It had an orbital period of 88.6 min. Its height above the earth varied between 161 and 261 km. The satellite was launched at 14.47 U.T. from Cape Canaveral, made three revolutions around the earth, and landed safely into the Atlantic some 200 miles north-west of Puerto Rico at 19.43 U.T. after a flight of 296 min. During the voyage Glenn was able to keep in touch with his fellow astronauts at various tracking stations around the world, and people in many countries were able to listen to him by radio.

#### Phonon Branches in the Infra-red Spectrum of Solid Hydrogen

In the pressure-induced infra-red spectra of non-polar molecules the translational motion of the molecules plays an important role as a result of the fact that the induced dipole moments responsible for the absorption are strongly dependent on the intermolecular separations. In a crystal such as solid hydrogen, the presence of dipole moments induced by the intermolecular forces imparts infra-red activity to the lattice vibrations and a number of continuous absorption bands are observed. These bands, which may be called the phonon branches of the spectrum, constitute the most prominent features of the observed infra-red spectrum of solid

hydrogen. They result from transitions in which the change in the internal state of the molecules upon absorption of a photon is accompanied by a change in the state of the lattice vibrations, i.e., by the emission or absorption of one or more phonons. Besides these phonon branches the infra-red spectrum of solid hydrogen contains a number of absorption features arising from single or double rotational or vibrational transitions not accompanied by any phonon processes.

In a paper contributed to the *Canadian Journal of Physics* (1962, 40, 163), Poll and Van Kranendonk investigate theoretically the effect of lattice vibrations on the infra-red absorption spectrum of solid hydrogen and derive expressions for the integrated intensities of the phonon branches.

In contradistinction to the infrared spectrum, the Raman spectrum of solid hydrogen is not affected by the lattice vibrations in any spectacular way. The Raman spectrum is determined by the polarizability of the molecules and these are largely independent of the intermolecular separations.

#### The Transverse Stern-Gerlach Experiment

In the conventional Stern-Gerlach experiment a beam of neutral particles incident in the  $x$  direction passes through a region of an inhomogeneous magnetic field given by  $H(r) = H_0 k + H_1(y, z)j + H_2(y, z)k$ , where  $H_0 \gg H_1, H_2$ . The effect of the field on the motion of the particles in the  $z$  direction is considered, and it comes out that all those particles with spin directed upwards acquire a negative momentum change in passing through the inhomogeneous field, while all those with spin downwards acquire a positive momentum change. Thus the original beam is split into two distinct beams by the time it has reached a detector placed far from the inhomogeneous field.

Following closely the theoretical treatment of the conventional S-G experiment, M. Bloom and K. Erdman of the University of British Columbia, discuss the theory of what they call the Transverse Stern-Gerlach experiment in a paper in the *Canadian Journal of Physics* (1962, 40, 179). They show that if a beam of neutral spin  $\frac{1}{2}$  particles incident along the  $z$  axis is passed through an inhomogeneous, time-dependent magnetic field of the form  $H(r, t) = H_0 k + [h_1(x, y)i + h_2(x, y)j] \cos \omega t$  with  $H_0 \gg h_1, h_2$ , the beam is split into two beams in the  $(xy)$  plane when the resonance condition,  $\omega = \gamma H_0$ , is satisfied. The properties of the

beams are similar to those obtained in the ordinary Stern-Gerlach experiment.

Magnetic resonance measurements similar to those made using the Rabi modification of the Stern-Gerlach experiment may be performed with the transverse S-G experiment. The transverse S-G experiment may also be used to measure the magnetic moments of charged particles. Another interesting application is in the production of beams of polarized nuclei. Since this may be done with nuclei in ions, it may be possible to produce polarized beams of high intensity in a form useful to nuclear physics experiments.

#### Installation to Study Nuclear Processes of Matter

An installation to study the structure of elementary particles of matter by means of cosmic radiation of super-high energies is being assembled at the high mountain station of the Institute of Physics of the Georgian Academy of Sciences. The station is situated near Bakuriani in the Tskhra-Tskaro Pass at the altitude of 2,400 metres above sea level. The installation has a magnet weighing 1,000 tons with a magnetic field space of six cubic metres and two expansion chambers of 1,000 litres volume each in the magnet's gap.

The installation registers the interaction of super-high energy particles by means of an ionisation calorimeter. A definite amount of energy reached in the calorimeter actuates the expansion chambers and the picture of the interaction is automatically recorded on cine film by means of a special stereographic system. —(USSR News.)

#### Under-Water Current in the Atlantic

A Soviet expedition on board the "Mikhail Lomonosov" discovered an under-water current in the equatorial region of the Atlantic. In its physical properties this counter-current is similar to the Cromwell current discovered by the Americans in 1951 at the equator in the Pacific at the depth of 50 to 500 metres.

The countercurrent crosses the Atlantic in the west-to-east direction at the depth of a few hundred metres its speed being more than three kilometres per hour. The speed tapers off with depth. Between March and May 1961, the expedition carried out numerous measurements in the equatorial region of the Atlantic Ocean by means of self-recording instruments lowered to different depths. Each measurement lasted from 26 to 62 hours, and the final result was established after processing 49,000 pieces of information. This discovery substantially adds to our knowledge of the circulation of water masses in the Atlantic and is of great theoretical and practical value.

#### New Theory of Anaesthetic Action

A new theory to explain unconsciousness and the mechanism of action of an anaesthetic has been advanced at the California Institute of Technology, U.S. In this theory the action of anaesthetics is linked with the formation of compounds in which molecules of one substance are trapped in a network of molecules of another substance, such as water. These unusual compounds are called clathrate compounds. Water forms traps that look somewhat like the cells in a honeycomb except that they are five-sided instead of six-sided. The molecules of anaesthetics fit into the holes of water lattice structures containing 20, 24 or 28 molecules of water. The clathrate compounds thus formed are very small crystals that cause unconsciousness when they occur in the brain fluid.

The theory assumes that consciousness requires a constant interchange of electrical energy in the brain. The presence of micro-crystals in the brain interferes with the passage of electric currents from one brain cell to another causing unconsciousness.

This new approach to the understanding of unconsciousness should shed light on many mental problems. It may lead to the development of methods of restoring consciousness to persons subject to prolonged period of unconsciousness.—(Science News Letter, Press Information Bureau, Government of India.)

**D**URING the post-war period rapid growth in the facilities for world communication using transoceanic telephone cables has appeared as technically possible. Just recently this has been followed by proposals for radio repeater stations in space satellites providing cheap and unlimited communication facilities on an even greater scale. The subject has more than engineering importance.

The artificial satellite which communication engineers propose to use as a means of expanding world communications will act as a repeater station in space, having a line-to-sight path to the earth stations with which it communicates. Because radio communication will no longer depend on reflection from the ionosphere it will be possible to use that part of the radio spectrum between about 1000 and 10,000 Mc./s. This has a communication capacity several hundred times that of the H.F. band at present used.

#### PASSIVE SATELLITES

The most elementary form of communication satellite consists of a simple reflector travelling round the earth at a height of a few thousand miles. President Eisenhower used a satellite of this kind to deliver a Christmas message in 1958. A more serious test of the feasibility of relaying radio signals over long distances by 'bouncing' them from passive reflecting surfaces was made in 1960 when the United States National Aeronautics and Space Administration (NASA) put a 100 ft. diameter metallized plastic balloon into orbit at a height of about 1000 miles. This was known as the ECHO balloon and was used to reflect telegraph, telephone and facsimile signals transmitted between a NASA station in California and the Bell Telephone Laboratories at Holmdel, New Jersey.

Even when highly directional antennas are used on the ground, only a very small proportion of the energy radiated by the transmitter will hit a passive satellite and an even smaller part will be reflected back and dispersed over the earth's surface. Because of this, very high power transmitters would be needed to achieve communications using passive satellites at heights of interest. It is not only difficult to generate this high power at microwave frequencies but a transmitter of the power required would give rise to considerable interference.

For this reason active satellites are more likely to be used for communication purposes. They will contain electronic repeaters which will amplify the received signals before re-transmitting them back to earth.

#### ACTIVE SATELLITES

The kinds of active satellite which have been most discussed are:

- (1) Satellites in circular orbits at heights between 2,000 and 6,000 miles. Each will complete a circuit of the earth in 3 to 8 hours and appear to move fairly rapidly across the sky. A number will be required that at least one is always visible to both terminal radio stations.
- (2) Satellites in circular equatorial orbits at a height of 22,300 miles. At this height a satellite makes one rotation every 24 hours and therefore appears stationary relative to a point on the earth's surface.

An American proposal of the first kind would employ 50 satellites at a height of 3,000 miles to provide world-wide communication. The satellites are divided into three sets in orbits making angles of 60° with each other. A variant of this, suggested in the United Kingdom, is for the use of satellites in elliptical orbits with perigees 300 miles high and apogees from 10,000 to 12,500 miles. Provided the orbits can be maintained in their relative angular positions, 12 satellites would provide complete global coverage.

All low-orbiting satellites, active or passive, require steerable transmitting and receiving antennas on the ground which can be continuously directed on to them. Dishes, 60 or 80 ft. in diameter, will probably be used. In a commercial system these would have to be duplicated at each ground-station in order to prevent interruption of communications during the period when one satellite is beginning to pass out of view and another taking its place as the communication link. Because of the, desirably, very narrow beamwidth of the ground-station steerable antenna, automatic tracking of the satellite will be necessary. This will be controlled by a signal returned from the satellite.

The second kind of proposal which makes use of satellites with an orbital period of 24 hours has a number of obvious advantages. At this height a satellite will 'look-at' nearly half the earth's surface and only three such satellites

\* From the Presidential Address of Sir Gordon Radley, K.C.B., delivered to Section G (Engineering) on August 31, 1961, at the Norwich Meeting of the British Association. By courtesy of the B.A.A.S.

would be required to provide for communication between any two points on the earth's surface.

Because the satellite will remain stationary relative to the transmitters and receivers with which it communicates, the design of the ground-station equipment is simplified. On the other hand, the distance of about 45,000 miles which the radio signals have to traverse in a trip, ground-satellite-ground, introduces a delay of 240 milliseconds into their transmission, or about a half-second before a reply can be received. For the transmission of telegraphy data, television and many other kinds of communication this does not matter. Communication engineers are as yet uncertain whether delays of this order would be troublesome in a telephone conversation.

#### SATELLITE POWER SOURCES

Power to operate the electronic equipment in an active satellite will be obtained initially from the sun although the long-term development of light-weight nuclear sources must not be ruled out. Much work has been done during the last 5 years on the development of the solar cell, principally by the Bell Telephone Laboratories in the United States. Although the cell, in its present form, is not yet satisfactory for long-term service in a satellite, it seems reasonable to plan on the assumption of its use in the future.

The solar cells may be supported on 'sails' at the sides of the satellite, extended after the satellite has settled in its orbit. They will have to provide an area of one or two square yards in order to generate enough power to operate the radio transmitter. During the time that a satellite is in the shadow of the earth, power will have to be supplied from storage batteries.

#### SATELLITE-TO-GROUND TRANSMISSION

Satellite communication systems will make use of frequencies in the same part of the spectrum as entirely ground-based, radio-relay systems. But the distance between relay stations in a land system is usually about 40 miles compared with 4,000 or much more to the satellite. Moreover, on land, highly directional transmitting and receiving aeriels enable signals to be beamed from station to station. Highly directional aeriels are almost impossible to arrange on a satellite and, in order to make use of any directivity, it is necessary to maintain altitude control of the satellite.

Taking both the increased distance and the lack of directivity together, the transmission

loss between a communication satellite and its ground station may be 80 dB—100 million times on a relative power basis—greater than the loss between two adjacent stations in a land radio relay system.

The problem is not serious in the direction ground-to-satellite because high transmitting powers can be used, fed into large parabolic antennas directed on to the satellite. It is serious in the other direction because the power of the transmitter in the satellite is limited to 1 or 2 watts and the signals it sends out are dispersed over a very large part of the earth's surface.

Amplification of these weak signals by means of a device which itself has very low intrinsic noise is the nub of the problem. Because of the thermal agitation of its molecules, every element of an electrical circuit produces spontaneous unwanted noise signals at radio frequencies. It has become common to measure this noise in terms of the equivalent temperature of its source; for a conventional amplifier this may correspond to 3000° K. The invention of the 'maser' provided the engineer with low-noise amplifying devices of a new kind. Taking advantage of the principles of quantum mechanics, a very weak incoming signal is able to trigger a great amount of power over a limited frequency range. The problem generally is to extend this range, but 'masers' have been constructed with a frequency coverage adequate for a satellite communications system.

#### MODULATION METHODS

The economics of satellite communication suggest planning in terms of at least 600 two-way telephone channels, or one two-way television channel. It remains necessary to mention the way in which the messages will be impressed on the radio signal. Information theory tells us that by increasing the transmitted frequency band, it is possible to improve the signal-to-noise ratio without increasing transmitter power. Frequency-modulation is a technique frequently used for this purpose. Pulse-code modulation, in reality a method of processing information before applying it to any type of radio transmission, has many attractions. The important feature of both is their relative freedom from interference but fairly wide bandwidths are required and it is likely that at least 250 Mc./s. will be needed by each satellite system for two-way communication on the scale envisaged.



VIBRATIONAL SPECTRUM OF *o*-AMINO-BENZENETHIOL

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THE vibrational spectrum both Raman and infra-red, of *o*-amino-benzenethiol, has been investigated and the assignments of the different frequencies have been attempted on a close analogy with that for benzenethiol<sup>1</sup> and other substituted benzenes.<sup>2,3</sup> The infra-red spectra have

dispersion of 19 Å/mm. in the  $\lambda$  4358 region and a Hilger Raman Source Unit. The Raman and infra-red spectra, and the estimates of intensity in the conventional manner are given in Table I. The vibration types—class and mode—have been designated according to Wilsons' notation.<sup>4</sup>

TABLE I  
Vibrational assignments of *o*-Amino benzenethiol

Frequency in cm. <sup>-1</sup>			Tentative Assignments		
Raman	Infra red		Class	Mode	
In liquid	Liquid	In CCl <sub>4</sub>			
172 (8)	..	..	B <sub>2</sub>	16 <i>b</i>	X sensitive vibrations of C <sub>6</sub> H <sub>5</sub> X
264 (8)	..	..	B <sub>2</sub>	11	
373 (6)	..	..	B <sub>1</sub>	16 <i>a</i>	
479 (6)	..	..	A <sub>1</sub>	6 <i>a</i>	
678 (9)	674 (w)	674 ( w)	A <sub>1</sub>	12	
1093 (5)	..	..	A <sub>1</sub>	7 <i>a</i>	
561 (8)	..	..	B <sub>1</sub>	6 <i>b</i>	In-plane ring deformation (606 cm. <sup>-1</sup> in benzene)
693 (1)	..	..	B <sub>2</sub>	4	Out-of-plane ring deformation
751 (6)	746 (s)	741 (s)	B <sub>2</sub>	10 <i>b</i>	Out-of-plane C—H deformations
834 (9)	844 (w)	840 (sh)	A <sub>2</sub>	10 <i>a</i>	
..	932 (w)	932 (m)	B <sub>2</sub>	17 <i>b</i>	
..	..	968 (m)	A <sub>2</sub>	17 <i>a</i>	
..	1084 (m)	1086 (s)	B <sub>2</sub>	5	
909 (5)	905 (m)	907 (s)	..	..	C—S—H in-plane deformation
1023 (10)	1024 (m)	1024 (s)	A <sub>1</sub>	18 <i>a</i>	In-plane C—H deformation
1154 (5)	1155 (m)	1155 (s)	B <sub>1</sub>	9 <i>b</i>	
..	1139 (w)	1139 (m)	A <sub>1</sub>	9 <i>a</i>	
1261 (6)	1250 (w)	1250 (m)	B <sub>1</sub>	3	
1302 (8)	1299 (s)	1299 (vs)	B <sub>1</sub>	14	C=C stretching
..	1447 (s)	1449 (s)	B <sub>1</sub>	19 <i>b</i>	
1484 (4)	1481 (s)	1479 (s)	A <sub>1</sub>	19 <i>a</i>	
1581 (9)	..	..	B <sub>1</sub>	8 <i>a</i>	
1606 (9)	1610 (s)	1608 (s)	A <sub>1</sub>	8 <i>b</i>	
..	..	1625 (sh)	..	..	N—H in plane deformation
2533 (7)	2510 (m)	2538 (s)	..	..	S—H stretching in <i>cis</i>
..	..	2600 (m)	..	..	S—H stretching in <i>trans</i>
3048 (7)	3030 (w)	3030 (m)	B <sub>1</sub>	7 <i>b</i>	C—H stretch
3071 (7)	3067 (w)	3067 (w)	A <sub>1</sub>	2	
3350 (5)	3338 (s)	3361 (s)	..	..	N—H symmetric stretch
..	3419 (s)	3460 (s)	..	..	N—H asymmetric stretch

N.B.—s=strong, vs=very strong, m=medium, sh=shoulder, w=weak. Concentration for the IR spectrum in CCl<sub>4</sub> is not given because the change in concentration has made no variation in frequency.

been recorded with a Model 21 Perkin-Elmer Double Beam IR spectrophotometer with NaCl optics, and the Raman spectrum has been recorded with a Fuess Glass Spectrograph, with a

In the Raman spectrum the S—H stretching frequency appears as a broad intense band extending from 2516 to 2550 cm.<sup>-1</sup> The line at 909 cm.<sup>-1</sup> can be assigned to C—S—H in-plane

deformation. In the infra-red the corresponding frequencies appear as a weak broad band at  $2510\text{ cm}^{-1}$  and another at  $905\text{ cm}^{-1}$  respectively. In solutions of  $\text{CCl}_4$  the S—H stretching frequency in the infra-red shifts to  $2538\text{ cm}^{-1}$ . Josien *et al.*<sup>5,6</sup> have observed a shift of this order in benzenethiol and other monohalogen benzenethiols. The frequency in solution, in these cases, corresponds to the frequency of benzenethiol vapour ( $2592\text{ cm}^{-1}$ ). Hence the shift in frequency while going from pure liquid state to the dilute  $\text{CCl}_4$  solution has been explained as due to the breaking of the intermolecular association. Accordingly the liquid frequency at  $2510\text{ cm}^{-1}$  and the frequency in  $\text{CCl}_4$  at  $2538\text{ cm}^{-1}$  can be assigned to the bonded and free S—H stretching frequency in *o*-amino-benzenethiol.

In addition to this in solutions of  $\text{CCl}_4$  another band appears at  $2600\text{ cm}^{-1}$  which is comparable in intensity with the one at  $2538\text{ cm}^{-1}$ . These two bands do not show any relative variation in intensity with concentration. Josien *et al.* have observed a weak band in *o*-chloro, and *o*-bromo benzenethiols, below the S—H frequency and  $2552\text{ cm}^{-1}$  and  $2545\text{ cm}^{-1}$  respectively. In the *meta* and *para*-isomers no such band was reported.

The presence of this band at  $2600\text{ cm}^{-1}$  in the vicinity of the S—H band at  $2538\text{ cm}^{-1}$  suggests the existence of *cis* and *trans* isomers as in the case of *ortho* phenols, where the *cis* isomers are stabilized relatively by the interaction with the *ortho* substituent. Therefore in the case of *o*-amino benzenethiol the bands at  $2538$  and  $2600\text{ cm}^{-1}$  can be assigned to the *cis* and *trans* species respectively. The value of S—H stretching frequency at  $2538\text{ cm}^{-1}$  which is low when compared with the S—H stretching frequency in benzenethiol at  $2570\text{ cm}^{-1}$  and other sulphohydril compounds indicates an intermolecular interaction between the amine and the SH group in the *cis* configuration. On the other hand the *trans* frequency at  $2600\text{ cm}^{-1}$  is about the same as the free S—H stretching frequency in benzenethiol at  $2592\text{ cm}^{-1}$ . The *cis* form being more stable these molecules would be in greater abundance than the *trans* ones.<sup>7</sup> This is verified from the much greater intensity of the band corresponding to the *cis* form when compared to the other.

The distance between the nitrogen of the amino group and the hydrogen of the SH group has been calculated with the values of the bond distances and interbond angles taken from related molecules like benzene, methanethiol

and aniline. This distance comes out as  $2.3\text{ \AA}$ , which would permit such an interaction. There is considerable evidence in literature for the formation of an intermolecular S—H...N bond where shifts of the order of  $100\text{ cm}^{-1}$  in the S—H frequency have been reported.<sup>8-10</sup>

Of the two C=C stretching vibrations corresponding to the modes *8a* and *8b*, only the former appears in benzenethiol at  $1581\text{ cm}^{-1}$  while in its *ortho* amino-derivative both of them appear as very intense Raman lines at  $1581$  and  $1606\text{ cm}^{-1}$ . In the infra-red only the latter appears as a strong band at  $1610\text{ cm}^{-1}$ . The intense and strongly polarised Raman line of benzene at  $992\text{ cm}^{-1}$  arising out of the totally symmetric oscillations appears in benzenethiol at  $1000\text{ cm}^{-1}$  but is completely suppressed in the Raman spectrum of *o*-amino benzenethiol. Such a suppression of this line in the spectra of hydroxy benzaldehydes has been reported earlier by Puranik and Venkata Ramiah.<sup>11</sup> The two Raman lines at  $834$  and  $751\text{ cm}^{-1}$  with a strong infra-red absorption corresponding to the latter at  $746\text{ cm}^{-1}$  can be assigned to the out-of-plane deformation modes *10a* and *10b*. The  $B_2$  out-of-plane ring deformation which occurs in benzenethiol at  $688\text{ cm}^{-1}$ —strong both in Raman and infra-red—appears only in Raman as very weak line at  $693\text{ cm}^{-1}$  in *o*-amino benzenethiol. One component of the  $E_{2g}$  class (*6b*) vibration of benzene is scarcely changed in mode in the monosubstituted derivatives. However on *ortho*-substitution there is a shift towards the lower frequency depending on the nature of the substituents. This line appears at  $615\text{ cm}^{-1}$  in benzenethiol. Therefore a Raman line at  $561\text{ cm}^{-1}$  in *o*-amino benzenethiol can be assigned to this mode.

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## X-RAY STUDY OF STRUCTURAL IRREGULARITIES IN DEFORMED METALS\*

Recent Trends in Interpretation of Debye-Scherrer Line Shapes and Breadths

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## INTRODUCTION

A METAL or alloy is said to be cold-worked or plastically deformed whenever it is strained beyond its elastic limit below its recrystallization temperature. Most metals are plastically deformed by mechanical operations like rolling, drawing, cutting, machining, hammering, filing, etc., at room temperature. The cold-worked metal is characterized by many structural irregularities, but reverts to its normal state on annealing, i.e., heating above its recrystallization temperature, holding there for a sufficient time and cooling slowly to room temperature. Interest in the X-ray study of deformed structures dates back to 1925 when Van Arkel<sup>1</sup> reported that Debye-Scherrer reflections from cold-worked metals are broad and diffuse as compared to the sharp reflections from annealed ones. Until 1950 the observed X-ray diffraction broadening was attributed to two effects of cold work, viz., fragmentation into small coherently diffracting domains and residual internal strain, but the contribution of deformation stacking faults has been increasingly recognised in recent years. Many comprehensive reviews<sup>2-6</sup> have appeared in the last decade focussing attention on the intense research activity in this field and its importance in elucidating the mechanism of plastic deformation in terms of the movement, interaction, multiplication and redistribution of dislocations and other lattice defects in annealed metals.

This review deals with the effects of the structural irregularities introduced by cold work on Debye-Scherrer reflections from the two typical metallic structures, viz., the face-centred cubic (f.c.c.) and the hexagonal close-packed (h.c.p.), and their quantitative evaluation either by simple and quick analytical procedures involving line breadths or by complex and time-consuming Fourier Transform methods utilizing line shapes. A few simplifications and generalizations have proved inevitable in presenting this bird's-eye view of a very wide field of research, but it is hoped that the original papers

will be referred to by those interested in further work.

The notation used is explained at the end.

## ANALYSIS OF LINE BREADTHS

The convenient starting point for line breadth or Fourier analysis of X-ray diffraction broadening is the accurate photometric or counter-diffractometric record of Debye-Scherrer reflections from the test metal in both the deformed and annealed states.  $B$  and  $b$  refer to one component of the normal Debye-Scherrer doublet and can be arrived at by graphical resolution<sup>7</sup> or by an analytical procedure.<sup>8</sup>  $\beta$  is then determined with the aid of one of the following equations:

$$\beta = B - b \quad (1)$$

$$\beta = (B^2 - b^2)^{\frac{1}{2}} \quad (2)$$

$$\beta = [(B^2 - b^2)^{\frac{1}{2}} \cdot (B - b)]^{\frac{1}{2}} \quad (3)$$

$$\beta = B - \frac{b^2}{B} \quad (4)$$

Equations (1) and (2) are based on the assumption that the profiles leading to  $B$ ,  $b$  and  $\beta$  are all expressible as Cauchy functions<sup>9</sup> ( $y = 1/(1 + m^2x^2)$ ) and Gaussian functions<sup>10</sup> ( $y = e^{-m^2x^2}$ ) respectively. In actual practice, however, the profile for  $b$  rarely follows either function and can be expressed only by functions like:  $y = 1/(1 + m^2x^2)^2$ . The profile for  $\beta$  is more often a composite of the Cauchy profile for  $\beta_D$ , the Gaussian profile for  $\beta_S$  and the more complex profile for  $\beta_F$ . The third<sup>11</sup> and the fourth<sup>12</sup> equations are based on line profiles intermediate between Cauchy and Gaussian and may be considered the more satisfactory for any preliminary line breadth analysis.

If  $\beta$  is exclusively due to one cause, the following well-established relations will lead to  $\eta$ ,  $\epsilon$ ,  $\sigma$  or  $a$  values with very small mean deviation from the mean value for a number of  $hkl$ - or  $HKIL$ -reflections:

$$\beta_D = \frac{\lambda}{\eta \cos \theta} \quad (5)$$

$$\beta_S = \frac{4\epsilon}{\cot \theta} \quad (\text{for isotropic strain}) \quad (6)$$

$$\beta_S = \frac{4\sigma}{E_{hkl}} \cdot \cot \theta \quad \text{or} \quad \frac{4\sigma}{E_{HKIL}} \cdot \cot \theta \quad \left. \vphantom{\frac{4\sigma}{E_{hkl}}} \right\} \quad (\text{for isotropic stress}) \quad (7)$$

\* Based on a talk delivered at the 27th Annual Meeting of the Indian Academy of Sciences held at Mysore in December 1961.

$$\beta_F = \frac{2\lambda^2 \cdot L [1 - (1 - 3\alpha + 3\alpha^2)^{\frac{1}{2}}]}{c^2 \cdot \sin 2\theta [1 + (1 - 3\alpha + 3\alpha^2)^{\frac{1}{2}}]} \quad (8)$$

or

$$\frac{\lambda^2 (h + k + l) [1 - (1 - 3\alpha + 3\alpha^2)^{\frac{1}{2}}]}{a^2 \cdot \sin 2\theta [1 + (1 - 3\alpha + 3\alpha^2)^{\frac{1}{2}}]}$$

Most deformed f.c.c. and h.c.p. structures display X-ray line broadening that can be explained only as due to more than one cause, if not all three causes. In such cases, the problem can be simplified to one of separating  $\beta_D$  and  $\beta_S$ . Stacking faults in h.c.p. metals broaden only some Debye-Scherrer reflections,<sup>13</sup> viz., those with  $H - K \neq 3N$  and  $L \neq 0$ , and hence some  $\beta$  values can be used to determine  $\alpha$  according to equation (8) and the others to separate  $\beta_D$  and  $\beta_S$ . In f.c.c., metals, all X-ray reflections are broadened by stacking faults, but  $\beta_F$  can be calculated for each of them from  $\alpha$  arrived at from observed peak shifts.<sup>14</sup> A fault-corrected standard breadth can then be evaluated by compounding  $b$  and  $\beta_F$  according to equation (4) for further analysis.<sup>15</sup>

The following relations have been derived for separation of  $\beta_D$  and  $\beta_S$ :

$$\beta = \beta_D + \beta_S \quad (9)$$

$$\beta = \beta_D \cdot \left( \frac{1 - \beta_S}{B} \right)^{\frac{1}{2}} + \beta_S \quad (10)$$

$$B^2 = \beta_D^2 + \beta_S^2 + b^2 + 2b\beta_D. \quad (11)$$

Equation (9) has no justification except its simplicity<sup>16</sup> and equation (10) is based on the assumption that equation (4) is generally the best for compounding any two X-ray line profiles.<sup>17</sup> Equation (11) is perhaps the best of all, as it utilizes Cauchy and Gaussian profiles for  $\beta_D$  and  $\beta_S$  respectively and involves the least assumptions.<sup>18</sup> In any case, the values of  $\eta$  and  $\epsilon$  or  $\sigma$  arrived at from a pair of X-ray reflections should lead to  $\beta$  or  $B$  values for other reflections deviating the least from the originally determined  $\beta$  or observed  $B$  values respectively.

#### FOURIER ANALYSIS OF LINE SHAPES

The intensity distribution in the graphically resolved components of any Debye-Scherrer doublet is generally symmetrical about the peak and can be expressed as a cosine Fourier series in terms of a reflection of indices ( $ool'$ ). The following Fourier series<sup>19</sup> for the profile giving  $\beta$  can be arrived at from the two Fourier series corresponding to the profiles for  $B$  and  $b$ :

$$P_{2\theta} = M \sum_n A_n \cdot \cos 2\pi n x. \quad (12)$$

The Fourier Coefficients  $A_n$  are arrived at by dividing the coefficients of the profile for  $B$  with the corresponding coefficients of the profile for

$b$ , the whole process involving time-consuming and dreary summations in the absence of computers. Every  $A_n$  value is then a product of three coefficients,<sup>20</sup> each characteristic of one structural irregularity:

$$A_n = A_n^D \cdot A_n^S \cdot A_n^F \quad (13)$$

where

$$A_n^D = \frac{1}{\eta} \sum_{i=n} (i-n) P_i \quad (14)$$

$$A_n^S = \langle \cos 2\pi n l' \epsilon \rangle \quad (15)$$

$$A_n^F = [(1 - 3\alpha + 3\alpha^2)^{\frac{1}{2}}]^n. \quad (16)$$

It is possible in principle to separate the three coefficients by an extrapolation method,<sup>21</sup> but in practice it is simpler to calculate  $A_n^F$  from  $\alpha$  computed from peak shifts<sup>22</sup> or to consider only reflections unaffected by stacking faults.<sup>18</sup> The problem simplifies therefore to one of separating  $A_n^D$  and  $A_n^S$ .

When measurements for several orders of ( $ool'$ ) are available, it follows from equations (14) and (15) that  $A_n^D$  is independent of the order, but  $A_n^S$  is a function of  $l'$  and equals unity for  $l' = 0$ . As  $A_n$  is now a product of only  $A_n^D$  and  $A_n^S$ ,

$$\ln A_n(l') = \ln A_n^D + \ln A_n^S(l') \quad (17)$$

and if  $\ln A_n(l')$  is plotted against some function of  $l'$  for a fixed value of  $n$ , the intercept at  $l' = 0$  gives  $\ln A_n^D$  directly.<sup>23</sup> The extrapolation to  $l' = 0$  is most reliable when  $A_n(l')$  is plotted against  $l'^2$ .

When data for only one reflection are available, it can be shown on the basis of dimensional disregard of the domains that<sup>24</sup>

$$\frac{dA_n}{dn} \Big|_{n=0} = \frac{dA_n^D}{dn} \Big|_{n=0} = \frac{dA_n^S}{dn} = -\frac{1}{\eta}. \quad (18)$$

$\eta$  is then evaluated by measuring the initial slope of the  $A_n$  vs.  $n$  curve.

A third way of separating the effects of  $\eta$  and  $\epsilon$  is to get back the profile of pure diffraction broadening due to them and analyse it as a Voigt profile made up of one Cauchy and one Gaussian profile.<sup>25</sup> Although the work involved is heavy, a complete separation of the profiles due to  $\eta$  and  $\epsilon$  is achieved here without any assumption.<sup>17</sup>

#### CONCLUSION

Although the above methods of analysing X-ray diffraction broadening due to cold work have been applied in recent years to many

metals and alloys, our present understanding of the mechanism of plastic deformation in metallic structures is far from satisfactory. Values of  $\alpha$  and  $\epsilon$  going up to as high as 0.15 and 0.008 respectively and of  $\eta$  going down to as low as 150 Å have been reported, but the nature of the strain, the significance of the domain size and the mode of distribution of stacking faults are yet to be clearly understood for most metals. Filings seem to represent a specially drastic state of cold work and display far more structural irregularities than plastically strained massive polycrystalline specimens. Further accurate and systematic experimental work on a large scale seems to be absolutely necessary before any clear general picture of the cold-worked state can possibly emerge to cover all metals and alloys.

# NOTATION USED IN THE TEXT

$\lambda$	.. Wavelength of X-radiation.
$\theta$	.. Bragg angle of Debye-Scherrer reflection.
$b$	.. Integral breadth (i.e., total integrated intensity divided by peak intensity) of instrumental broadening (i.e., normal X-ray reflection from the annealed metal).
$B$	.. Integral breadth of X-ray reflection from the deformed metal.
$\beta$	.. Integral breadth of pure diffraction broadening.
$\beta_D, \beta_S, \beta_F$	.. Integral breadth of broadening due to domains, strain and stacking faults respectively.
$A_n$	.. Cosine Fourier Coefficient for pure diffraction broadening.
$A_n^D, A_n^S, A_n^F$	.. Cosine Fourier Coefficients for broadening due to domains, strain and stacking faults respectively.
$\eta$	.. Average size of domains in the deformed metal.
$\epsilon$	.. Average internal strain in the deformed metal, also referred to as $\langle \epsilon^2 \rangle^{1/2}$ .
$\sigma$	.. Average internal stress in the deformed metal.
$\alpha$	.. Deformation stacking fault parameter (i.e., area of faulted planes divided by

	total area of close-packed planes).
$E_{hkl}, E_{HKIL}$	.. Young's modulus in direction perpendicular to f.c.c. planes $\{hkl\}$ and h.c.p. planes $\{HKIL\}$ respectively.
$l'$	.. Index on conversion of $(hkl)$ or $(HKIL)$ to $(ool')$ on orthorhombic axes.
$a, c$	.. Only f.c.c. lattice parameter and second h.c.p. lattice parameter respectively.
$P_{2\theta}$	.. Distribution of intensity for pure diffraction broadening.
$P_i$	.. Fraction of columns of length $i$ cells.
$x, y$	.. Variables.
$M, m$	.. Constants.
$N, n$	.. Integers or Zero.

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## THE DESERT LOCUST IN INDIA\*

ONE feels some relief that this important and long-awaited monograph on "The Desert Locust, *Schistocerca gregaria* (Forsk.)", in India" has at last come out. It represents the results of field investigations carried out in undivided India during a period of nearly ten years (from December 1930 to the end of March 1939), by a team of research workers employed under the locust research scheme of the Indian (formerly Imperial) Council of Agricultural Research. These investigations were carried out partly at headquarters located first at Quetta and later at Karachi, and partly at the main Field Research Laboratory at Pasni (Baluchistan Coast) and at several smaller stations in Baluchistan, Sind and Rajasthan, as those areas of north-western India constituted the permanent breeding grounds of the Desert Locust in India. The manuscript of the monograph was ready for publication in the year 1945, but was actually published only in 1960, that is, fifteen years later! It is a matter for gratification that the author, who is active in spite of his 75 years, has been alive to see his *magnum opus* in print.

The work is divided into two parts. Part I (pp. 1-354) deals with "Studies on the Solitary Phase", and Part II (pp. 355-636) with "Studies on Past Locust Invasions in India". This is followed (pp. 637-721) by an Appendix p. 637), a list of references (pp. 638-644), a list of errata (pp. 645-647), and finally, long tabular statements (pp. 649-721) which could not be accommodated in the text-pages.

Part I is divided into five Sections. Section 1 includes an account of the genesis of Desert Locust investigation in India and a review of the progress of its work during the years 1931-39. Section 2 deals briefly with the physiographical, climatic, vegetational and faunal characteristics of the Indo-Iranian region. Section 3 gives an account of locust survey methods employed, as well as details of the distribution and activities of the Desert Locust in India year by year during the period 1931-38. Section 4 deals with the results of various "experimental studies" (such as those on food-preferences, the number

of generations, etc.), "ecological studies" and studies on biometry (measurement of body-parts of the locust in relation to various factors). Section 5 is devoted to general conclusions, such as results of an analysis of the survey data, a summary of evidence on the seasonal migrations of the "solitaries", and similar other matters.

Part II, which deals with the analyses of the locust invasions in India for various periods of years between 1861 and 1939 in correlation with climatic and weather data, is divided into seven Sections. The close relationship of locust movements with the climatic conditions is clearly brought out. In the last Section are given a short account of two other locusts in India (namely the Bombay Locusts, *Patanga succincta*, and the Indian Migratory Locust, *Locusta migratoria*), and a brief discussion of the apparent correlation noted between sunspot cycles and locust periodicity in India. This is followed by a useful list of local names of the Desert Locust in the different regions of its occurrence.

The monograph is an impressive document which provides us with a handy account of various items of work (some of which had been already published earlier elsewhere) carried out under the I.C.A.R. locust scheme, and the author is to be warmly congratulated upon its production. It should be stated, however, that besides this important work, various other publications relating to the Desert Locust have appeared in India from time to time during the last twenty years or so. Mention may be made in this connection of the works of M. A. Husain *et al.* (1933-49) on the biology of the locust, of K. R. Karandikar (1933-42) on its external morphology, of S. D. Misra (1946-53) on its somatic musculature, etc., and of M. L. Roonwal (1936-61) on its eye-stripes, phases and population dynamics. The last author has also recently brought out (Roonwal, *Rec. Indian Mus.*, Delhi, 1961, 56, 611) a complete world bibliography of the locust and grasshopper family Acrididae containing over 7,000 references.

\* *The Desert Locust in India*. By Y. Ramchandra Rao (Indian Council of Agricultural Research, New Delhi). Monograph No. 21, 1960. Pp. xix+721, Price Rs. 73+50.

It is, however, regrettable that both the editing and printing are far from satisfactory. There is a 3-page list of errata (pp. 645-647), which does not, by any means, seem to exhaust the

actual number of printing errors. The paper used is of poor quality and the binding is rather flimsy and can hardly be expected to stand frequent handling. Art paper need not have been used for printing text-figures, and many of the plates are left unnumbered. Page 644 is apparently a gross misplacement. There are neither page headings nor an index — both so essential for so large a work. On the title page, it is shown that the monograph is published by the Indian Council of Agricultural Research, but on the reverse side the Manager of Publications,

Delhi, claims that privilege. The author cannot obviously be blamed for these drawbacks!

Despite all the above defects, the publication under review will prove to be useful and interesting to students of Zoology — especially those engaged in agricultural entomology, and in respect of research workers on locusts this monograph would serve both as an important source of original material and as a valuable book of reference. It should find a place in the libraries of all Zoological and Agricultural Institutions.

M. L. ROONWAL.

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## OBITUARY

### DR. C. MAHADEVAN

**T**HE sudden death of Dr. C. Mahadevan, Head of the Department of Geology, Andhra University, Waltair, on April 8, 1962, will be deeply mourned by his many friends and colleagues. Dr. Mahadevan held a prominent position in Indian Geology and was noted for his pioneering research in India on the X-ray investigation of coals.

Dr. Mahadevan was born on May 6, 1901. After graduating from the Madras University with Geology Honours in 1926, he came to work as a research student under Sir C. V. Raman. Professor Raman started him on a new line of research, namely, the investigation of coals by the method of X-ray diffraction. His assiduous work on this problem for over five years resulted in the publication of a number of papers of a fundamental nature, thus laying the foundation for what was then a comparatively new field of research in India for geologists. Mahadevan was awarded the D.Sc. degree of the Madras University for this work. His papers on the pleochroic halos in cordierite, biotite, etc., are also worthy of note.

From 1931 to 1944 Dr. Mahadevan held the post of Geologist in the Geological Survey of the Hyderabad State. Among his contributions

during this period may be mentioned the study of the geology of Raichur and Sholapur districts, the Pakhals in the Godavary valley and the Bhima basin.

In 1945 he was appointed as the Head of the Department of Geology by the Andhra University which post he held till his death. Latterly, in addition, he was also the Principal of the University colleges which duties he relinquished just a week before his death.

Dr. Mahadevan was a Foundation Fellow of the Indian Academy of Sciences, and he represented Indian Geology in many International conferences and delegations.

Those who knew him in the early days of his career will remember Dr. Mahadevan's engaging conversations full of anecdotes, his enthusiasm for physical exercises, and his great liking for coffee of which he used to have a cup almost every two hours of the day. By his helpful nature, and fine human qualities he endeared himself to all his friends. Many will feel, as the present writer does, that in his death they have lost a personal friend.

A. S. GANESAN.

## LETTERS TO THE EDITOR

UREY-BRADLEY FORCE FIELD:  
C<sub>3</sub>O<sub>2</sub> MOLECULE

LONG *et al.*<sup>1</sup> favoured a linear structure for the C<sub>3</sub>O<sub>2</sub> molecule while Rix<sup>2</sup> has shown conclusive evidence for the structure to be of the C<sub>2h</sub> type. Assuming a planar centrosymmetric zig-zag model, belonging to the point group C<sub>2h</sub>, the potential constants of the molecule have been evaluated by Venkateswarlu and Krishna Pillai,<sup>3</sup> following Wilson's F-G matrix method. In the present investigation evaluation of force constants has been attempted on the above basis, using a Urey-Bradley potential force field.

## POTENTIAL FUNCTION

In the case of C<sub>3</sub>O<sub>2</sub> molecule belonging to the point group C<sub>2h</sub>, the two vibrations of *au* type are out-of-plane vibrations. All the other

where *r*'s are the bond lengths, *a*'s the bond angles, *q*'s the distance between the atoms not bonded directly and *r<sub>ij</sub>* represents (*r<sub>i</sub>*, *r<sub>j</sub>*)<sup>3</sup>. K', K, H, H', F' and F are the force constants, the last two of which are the repulsion constants between non-bonded atoms. Using the relation

$$q_{ij}^2 = r_i^2 + r_j^2 - 2r_i r_j \cos \alpha_{ij}$$

*q<sub>ij</sub>* can be expressed in terms of  $\Delta r_j$ ,  $\Delta r_i$  and  $\Delta \alpha_{ij}$ . The potential function contains six force constants, viz., K<sub>cc</sub>, K<sub>co</sub>, H<sub>cco</sub>, H<sub>ccc</sub>, F<sub>co</sub> and F<sub>co'</sub>. These six constants can be determined from the seven observed frequencies.

## RESULTS

The molecular parameters<sup>5</sup> and observed frequencies<sup>2</sup> of C<sub>3</sub>O<sub>2</sub> molecule are given in Table I.

TABLE I

Molecular parameters and observed frequencies (cm.<sup>-1</sup>) of C<sub>3</sub>O<sub>2</sub> molecule

<i>r</i>	R	<i>a</i>	σ <sub>1</sub>	σ <sub>2</sub> <sup>ad</sup>	σ <sub>3</sub>	σ <sub>4</sub>	<sup>ad</sup> σ <sub>5</sub>	σ <sub>6</sub>	σ <sub>7</sub>	<sup>bu</sup> σ <sub>8</sub>	σ <sub>9</sub>
1.19	1.28	158°	2185	817	577	1050	780	2258	1570	635	559

TABLE II

Urey-Bradley force constants (10<sup>5</sup> dynes/cm.)

K <sub>cc</sub>	K <sub>co</sub>	H <sub>cco</sub>	H <sub>ccc</sub>	F <sub>co</sub>	F <sub>co'</sub>
9.0330	15.5463	0.5012	0.4732	0.4400	0.0384

vibrations (3 *a<sub>u</sub>* + 4 *b<sub>u</sub>*) are planar. The G matrix follows directly from the original method of Wilson.<sup>4</sup> The internal co-ordinates and geometry of the system are shown in Fig. 1.

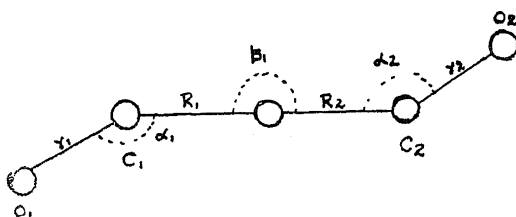


FIG. 1

Urey-Bradley potential function, in the general form, can be expressed as

$$V = \sum_{i=1}^4 K_i' r_i + \frac{1}{2} K_i (\Delta r_i)^2 + \sum_{i < j} H_{ij}' r_i^2 \Delta \alpha_{ij} + \frac{1}{2} H_{ij} (r_{ij} \Delta \alpha_{ij})^2 + \sum_{i < j} F_{ij}' q_{ij} \Delta q_{ij} + \frac{1}{2} F_{ij} (\Delta q_{ij})^2$$

The values of the force constants obtained in this investigation have been summarized in Table II, where K<sub>cc</sub>, the C-C stretching, K<sub>co</sub>, the C-O stretching, H<sub>cco</sub>, the C-C-O bending, H<sub>ccc</sub>, the C-C-C bending, F<sub>co</sub> and F<sub>co'</sub> are the C-O repulsion constants respectively.

One of the authors (R. T.) is thankful to the Council of Scientific and Industrial Research, Government of India, for the award of Junior Research Fellowship.

Department of Physics, K. VENKATESWARLU.  
Annamalai University, R. THANALAKSHMI.  
Annamalainagar, January 6, 1962.

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# ACETYLACETONE COMPLEXES OF CADMIUM AND LEAD: A POLAROGRAPHIC STUDY

THIS note reports a study of the polarography of acetylacetone complexes of cadmium and lead. A manual set-up was used for measuring the current-voltage curves using an H-cell with a saturated calomel electrode (S.C.E.) as a reference electrode. All experiments were carried out at  $30 \pm 0.5^\circ \text{C}$ . with deaerated solutions. The diffusion currents were corrected for the residual currents.

The capillary had the following characteristics:  $m^{2/3} t^{1/6} = 1.89 \text{ mg.}^{2/3} \text{ sec.}^{-1/2}$ . A Cambridge Bench Type pH Meter was used for the pH measurements. All chemicals were of Analar grade. Acetylacetone was dried and distilled before use. The purity of the reagent was checked by the density measurement. The concentration of acetylacetone corresponded to  $9.7 \times 10^{-2} \text{ M}$  when 0.1 ml. was diluted to 10 ml. The stock solutions of cadmium and lead were standardised by the gravimetric methods.

The experimental conditions and the results are shown in Tables I and II. In the case of

TABLE I  
Half-wave potentials of cadmium acetylacetonate complex at different pH

Cadmium =  $1.0 \times 10^{-3} \text{ M}$   
Acetylacetone =  $2.91 \times 10^{-1} \text{ M}$   
Ionic strength = 0.7

pH	$E_{1/2}$ vs. S.C.E. -V	$\Delta E$ -V	$-\log(A^-)$
7.97	0.660	0.078	1.56
8.12	0.667	0.085	1.43
8.36	0.681	0.199	1.23
8.75	0.690	0.115	0.96
8.85	0.704	0.122	0.89
9.1	0.718	0.136	0.70

TABLE II  
Half-wave potentials of lead acetylacetonate complex at different pH

Lead =  $1.0 \times 10^{-3} \text{ M}$   
Acetylacetone =  $2.91 \times 10^{-1} \text{ M}$   
Ionic strength = 0.7

pH	$E_{1/2}$ vs. S.C.E. -V	$\Delta E$ -V	$-\log(A^-)$
8.37	0.490	0.114	1.22
8.60	0.500	0.124	1.05
8.78	0.506	0.120	0.93
9.22	0.517	0.141	0.73
9.56	0.526	0.150	0.63

cadmium the ionic strength was maintained at 0.7 by the addition of requisite amounts of

potassium nitrate. No maximum suppressor was found necessary. In the case of lead the ionic strength was kept constant at 0.7 by the addition of suitable amounts of sodium perchlorate.  $1.0 \times 10^{-3}\%$  thymol in the final solution was used as a maximum suppressor. The pH in these cases was altered by the addition of alkali.

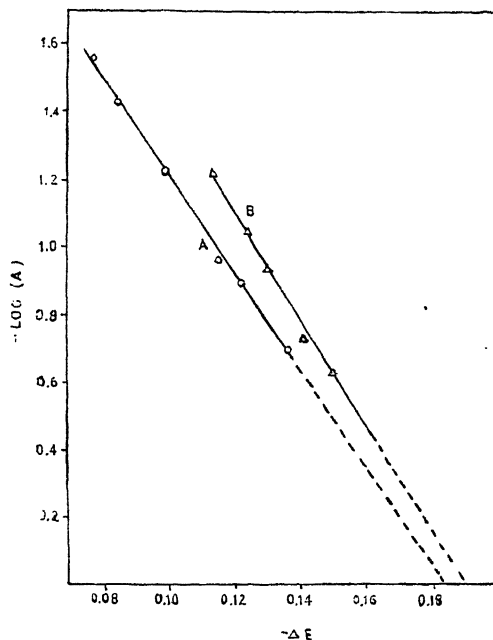
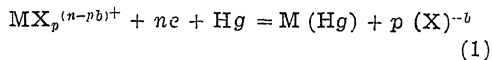


FIG. 1. Plot of  $\Delta E$  vs.  $\log(A^-)$  for cadmium and lead ion in acetylacetone solutions.

A—Cadmium. B—Lead.

The reduction of the complex metal ion to a metallic state (amalgam) may be represented by



where  $\text{X}^{-b}$  is the complex-forming substance. Lingane<sup>1</sup> has derived a relationship for the above reaction taking place rapidly and reversibly at the dropping mercury electrode, as given by

$$\frac{\Delta E}{\Delta \log(\text{X}^{-b})} = -0.06 \frac{p}{n} \quad (2)$$

where  $\Delta E$  is the change in the half-wave potential. The co-ordination number,  $p$ , can be determined from the slope of the plot of the half-wave potential vs.  $\log$  activity of the complex-forming substance. The dissociation constant

$$K = \frac{(\text{M}^{+2})(\text{X}^{-b})^p}{[\text{MX}_p^{(n-pb)+}]} \quad (3)$$

can be obtained from

$$\Delta E = (E_1)_c - (E_1)_s = \frac{0.06 \log K f_c k_s}{n f_s k_c} - \left(\frac{p}{n}\right) 0.06 \log (X^{-b}) \quad (4)$$

where the subscripts *s* and *c* refer to the simple and complex ions respectively.

The concentration of uncombined acetylacetone is obtained by subtracting the concentration of acetylacetone combined with the metal ions (assumed as  $MX_2$ ) from the total amount taken. The concentration of free acetylacetonate ion is calculated from the concentration of the free ketone, pH and the dissociation constant for acetylacetone.<sup>2</sup>

#### CADMIUM

The reversibility of the electrode reaction has been tested for each analysis by plotting  $\log [i/i_a - i]$  vs. *E*. A slope of  $31 \pm 2$  mV. indicates a two-electron reversible reduction. The half-wave potentials are obtained in the usual manner and are reproducible to  $\pm 2$  mV.

The half-wave potential for the simple ion is determined as  $-0.582$  V. vs. S.C.E. Table I gives the relative shift in the half-wave potential,  $\Delta E$ , and  $-\log (A^-)$ . A plot of  $\Delta E$  vs.  $-\log (A^-)$  for equation (2) (Fig. 1 A) is a straight line with the slope equal to 68 mV. and the co-ordination number *p* is therefore two. The concentration values are substituted in equation (4) since the activity coefficients are not known. An intercept of  $-0.1835$  V. is obtained and therefore

$$\frac{0.06 \log k_s}{2 k_c} + \frac{0.06}{2} \cdot \log K = -0.1835. \quad (5)$$

The ratio  $k_s/k_c$  determined from the experimental diffusion currents is 1.16. The pK value for the cadmium-acetylacetone complex has been calculated to be 6.12. The pK value for this complex has been reported by Izatt and others<sup>3</sup> at an ionic strength of zero from the glass electrode studies.

#### LEAD

A slope of  $30 \pm 1$  mV. for the log plot indicates a two-electron reversible reduction. The half-wave potential of the simple ion in this medium is measured as  $-0.376$  V. vs. S.C.E. A straight line plot (Fig. 1 B) for  $\Delta E$  vs.  $-\log (A^-)$  (Table II) with a slope of 62 mV. gives a co-ordination number of two. From the value of the intercept ( $-0.1895$  V.) and as has been shown for cadmium, the pK value for the lead complex has been calculated to be 6.32.

The authors wish to thank Dr. V. T. Athavale, Head, Analytical Division, for his kind interest and encouragement.

Analytical Division, S. C. SARAIYA.  
Atomic Energy Estab., V. S. SRINIVASAN.  
Trombay, Bombay, India, A. K. SUNDARAM.  
March 30, 1962.

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#### PRESENCE OF THORIUM IN THE ROCK SAMPLES OF THE DECCAN TRAPS

In 1941, Kalapesi, Chhapgar and Sukheswala<sup>1</sup> published a note on the age of the Deccan traps as determined by the "Lead-Ratio" method. They depended on the methods of chemical analyses of the rocks; but whereas they could determine with high accuracy the presence of uranium and lead, no trace of thorium was detected. Spectrochemical method of analysis has established the presence of thorium in rocks in minute traces.

Two samples of powdered rock, one from Bandra and one from Worli (Bombay) were supplied by Dr. Sukheswala, Head of the Geology Department, St. Xavier's College, Bombay.

The powders were examined on spectroscopic carbon electrodes "RW-1" made by Ringsdorf Werke—Mehlem/Rh.

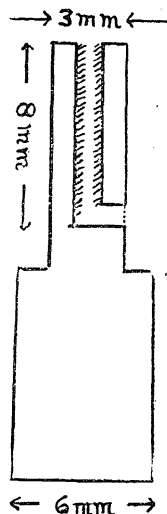


FIG. 1

According to Ahrnes,<sup>2</sup> there is some doubt regarding the persistent line of thorium, therefore the range from 2000 A.U. to 4000 A.U.

was carefully examined. The region 2000-2200 was photographed on plates treated with mineral oils. All the different techniques of arc and spark excitation were tried. The persistent line 2837·299 of thorium was the only line obtained.

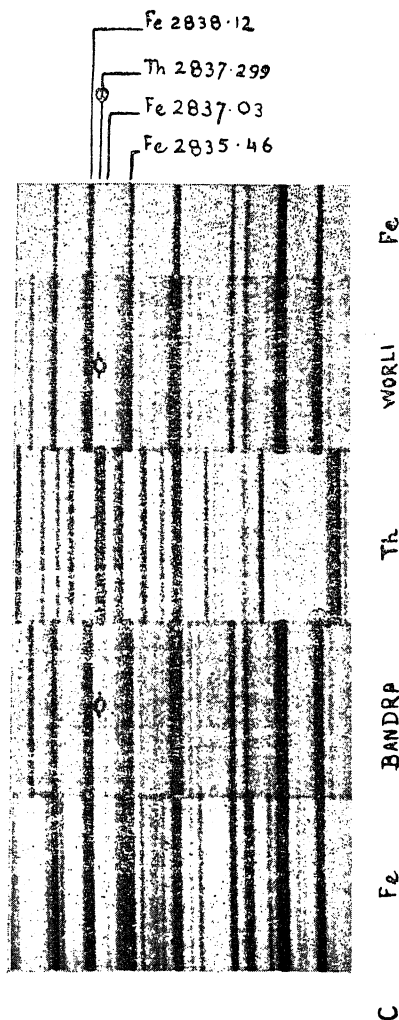


FIG. 2

This line was first obtained with the carbon arc cathode layer method, working with low intensity arc of 3 amperes. Thirty seconds after starting the arc, an exposure of about 2 minutes was given till the powder, which was in the carbon cup 1·5 mm. deep, was completely consumed. A total built-up exposure of fifty minutes was necessary to plainly discern the line. The thorium line was completely resolved from the iron line 2837·03. Once the existence

of the line was established, in order to obtain it quickly and of sufficient intensity, D.C. arc of 8 amperes was used and the slit was opened out to 10  $\mu$ . With this high current arc, it was found difficult to keep the powder in the electrode as it was easily blown away. In order to prevent this, the electrode was shaped as shown in Fig. 1.

The bore was 8 mm. deep and 1 mm. in diameter, and at its base, a horizontal bore was made. The powder was stuffed in the electrode and was wetted with distilled water and a fine iron needle was passed through the powder to make an air passage. With this arrangement, the arc was well anchored and the powder and the carbon were simultaneously consumed in 4·5 minutes. This electrode was made positive. The arc was 6 mm. long and the light from the centre of the gas column was allowed to fall on the slit. The spectrogram of Fig. 2 was obtained by this method.

Arhens (*loc. cit.*) has given only two sensitive lines of thorium—4019·137 and 2837·299. Zeiss atlas shows only the shorter wavelength in the arc.

4019 is a spark line of thorium, and even if it is obtained in the carbon arc it would be impossible to detect the same on account of the intense cyanogen bands in the region developed by the prolonged exposure. This line could not be obtained with the spark excitation, with voltages varying up to 20,000 volts and capacity up to 6  $\mu$ F. with one-hour exposures.

From the intensity of the thorium line 2837 in the arc, it must be concluded that this element is present in minute traces in the rock samples, almost at the threshold of the detection-limit by the spectroscopic method. This fact reduces the age of the lava flow and the previous estimates on the age of the Deccan Traps may require revision.

Department of Physics, S. J. KHAMBATA.  
St. Xavier's College,  
Bombay, March 26, 1962.

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# DISPERSION OF ULTRASONIC VELOCITY IN LIQUIDS

DISPERSION of ultrasonic velocity in liquids was first reported by Pinkerton<sup>1</sup> in the case of acetic acid in the frequency range of 0·5-4 Mc./sec. Subsequently other investigators reported dispersion in several liquids such as fatty acids,<sup>2</sup> castor oil,<sup>3</sup> glycerol<sup>4</sup> and high polymer solutions.<sup>5-7</sup> Carstensen<sup>8</sup> reported dispersion of a

very low order in milk using a modified pulse method which can detect changes in velocity of the order of 1 in 10,000. In the present communication the authors have presented the results of dispersion of ultrasonic velocity in a few liquids measured in the range of 1-9 Mc./sec. by extending the fixed path interferometer developed by Rao and Rao.<sup>9</sup>

In extending the fixed-path interferometer method for the study of dispersion of ultrasonic velocity, it is assumed that the velocity variation is negligible in a small frequency range of 100 Kc./sec., and hence the measured value in this range is taken to represent the velocity at the mid-frequency. Thus dividing the whole range of investigation into a number of small ranges of about 100 Kc./sec. and by determining velocities in those small ranges, the variation of ultrasonic velocity with frequency is studied. By using a toluene-mercury thermostat and an electronic relay circuit the temperature of the liquids is maintained constant at 30° C. to within  $\pm 0.1^\circ$  C. The results for all the liquids and solutions studied are presented graphically in Figs. 1 and 2. Measurements in the case of

particularly at higher frequencies. Of the liquids investigated castor oil,<sup>3</sup> and glycerine<sup>4</sup> have been previously studied. Definite dispersion of ultrasonic velocity in the frequency range of investigation is reported in all the other liquids for the first time. Proper care is taken to see that glycerine does not absorb any moisture.

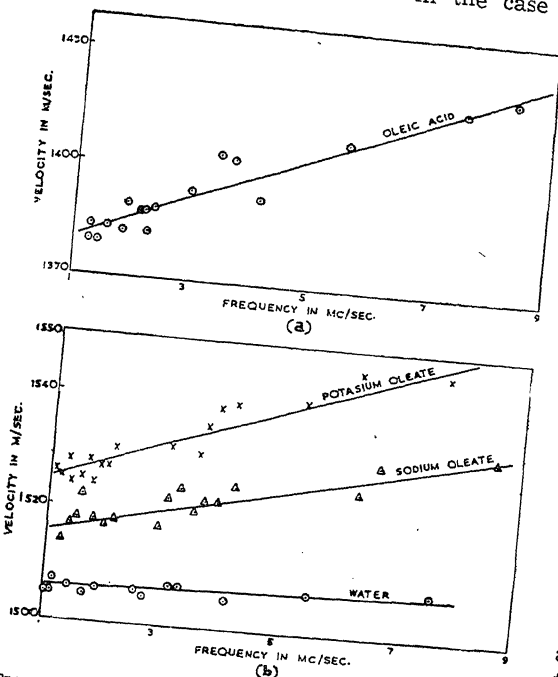


FIG. 1. Variation of ultrasonic velocity with frequency. The method, taken with a view to test the validity of the pulse method, showed a change of velocity of about 1 m/sec. over the frequency range of 1-9 Mc./sec. This difference is attributed to the inherent inaccuracy in the measurement.

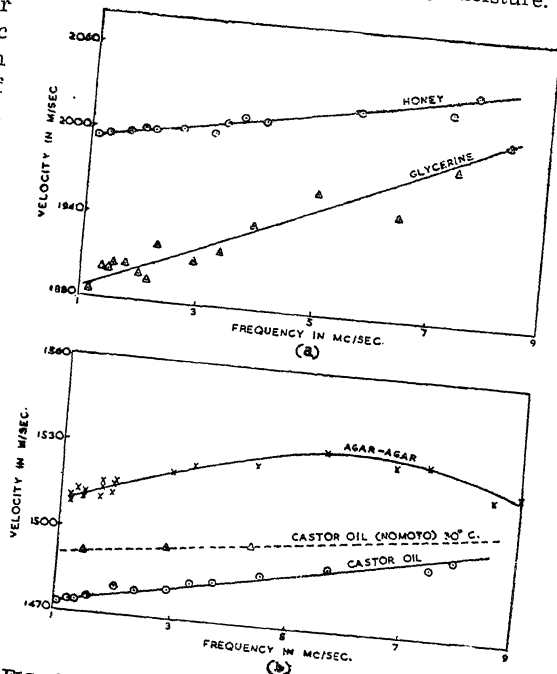


FIG. 2. Variation of ultrasonic velocity with frequency. In the present investigation glycerine exhibited a dispersion of velocity of about 120 m/sec. in the frequency range of 1-8.5 Mc./sec. This result cannot be compared with that of Piccirelli and Litovitz<sup>4</sup> who reported a dispersion of about 360 m/sec. at  $-14^\circ$  C. for the same frequency range. This difference may be attributed to the large difference in the temperatures in the case of these two investigations which results in a large change of viscosity and relaxational frequency. Castor oil studied at 27 m/sec. in the range of 1-8 Mc./sec. Comparing this with the results of Nomoto<sup>3</sup> who reported a velocity change of 16 m/sec. in the same frequency range and at the same temperature it can be seen that the agreement is satisfactory in view of the widely different samples used in the two investigations. Honey (from Mysore Govt. B.C. Society) and Oleic acid (B.D.H. sample, A.R. quality) showed no dispersion.

(3 gm. in 100 c.c.) and Potassium oleate (5 gm. in 100 c.c.) solutions in water exhibited dispersion of velocity of 16 m./sec. and 24 m./sec. respectively in the frequency range of 1-8 Mc./sec.

Agar-agar gel presented a peculiar variation of velocity with frequency in that the velocity increases with frequency up to about 6 Mc./sec. and then begins to decrease. The maximum change of velocity of about 25 m./sec. is observed in the range of 1-6 Mc./sec. This behaviour may be explained in the following way. The increase in velocity at low frequencies may be due to a relaxational mechanism. But as the frequency of the ultrasonics is increased they may interfere with the gel structure transforming it partly to a sol form, which begins to decrease the velocity. Exact relaxational frequency could not be obtained as the interferometer method cannot be extended to frequencies above 10 Mc./sec. The limitation of the high frequency end is the chief disadvantage of this method. But below 10 Mc./sec. accurate and quick measurements of dispersion of velocity can be made with the fixed-path interferometer.

Ultrasonic Research      M. G. SESHAGIRI RAO.  
Laboratories,              B. RAMACHANDRA RAO.  
Andhra University,  
Waltair, March 30, 1962.

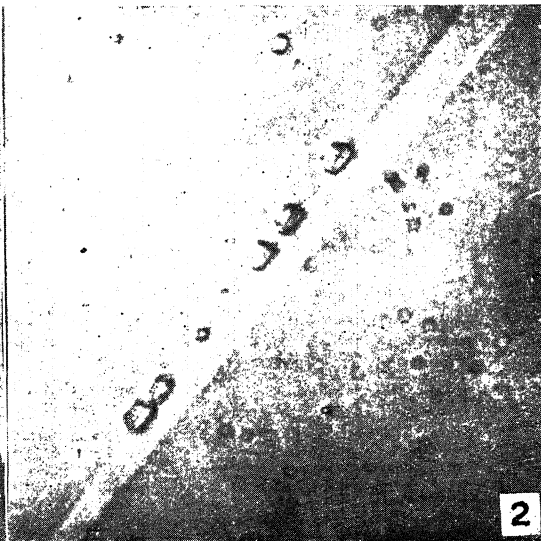
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### INCLINED DISLOCATIONS IN ZINC CRYSTALS

THE linear dislocation defects inclined to the cleavage plane of a zinc crystal, as revealed by etching, are reported here. Single crystals of zinc are grown from metal of high purity by Bridgman's method and cleaved at the temperature of liquid air. The freshly cleaved surface was etched by 0.05% iodine in ethyl alcohol and examined under a microscope. A number of hexagonal etch pits, which grow larger and deeper, with their edges getting rounded off on etching for longer times were observed. It has already been proved that these etch pits represent sites of dislocation defects running perpendicular to the basal plane of the crystal.

One interesting feature observed by us was that in some cases a small hexagon was seen inside a larger one. Figure 1 shows such a pit with the light profile running across for the measurement of its depth. Further examination shows that the inner and outer hexagons



are not concentric. This suggests that the pits may be due to the etching proceeding at an angle instead of vertically downwards due to the dislocation defects inclined to the surface. If the eccentricity  $a$  and the depth of the pit  $d$  are measured, then by applying the relation  $\tan \theta = d/a$  the inclination  $\theta$  of the dislocation defect can be calculated. Similar measurements have been made by Patel<sup>1</sup> on diamond. In the present case three such pits were observed and measurements gave a constant angle of  $36^\circ$  in all the three cases. Even though no conclusions can be drawn from three pits, it suggests it may have some bearing on the growth rate of the crystal. Experiments that are in progress on crystals grown at different rates may give some information on this topic. Recently, Grinburg<sup>2</sup> has shown that rates at which a crystal is pulled has some influence on the orientation of the crystals.

Another interesting feature observed by us is the partly developed pits along the edges of a twin lamella shown in Fig. 2. This is expected because of the heavy distortion taking place in the process of twinning which must have occurred at the time of cleavage.

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Baroda, February 28, 1962.

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### CHEMICAL EXAMINATION OF LICHENS OF THE ARAKU VALLEY

Two varieties of lichens collected during the winter months growing abundantly on the rocks and mango trees in the valley starting from Ananthagiri at an altitude of about 3000 ft. above sea-level (60 miles from Visakhapatnam) have been identified as (1) *Parmelia tinctorum* Desper and (2) *Ramalina tayloriana*.

Chemical examination of the first variety using ether gave lecanoric acid,  $176^\circ$  d. (5.2%) and atranorin, m.p.  $196^\circ$  (about 1%) along with colouring matters of the carotenoid type. Subsequent extraction with hot acetone yielded norstictic acid, m.p.  $283^\circ$  d. The appearance of norstictic acid seems thus to be of common occurrence in lichen species of *Parmelia tinctorum* Desper.

The second variety on extraction with ether gave two important acids: (1) Ramalinolic acid, m.p.  $163-64^\circ$  and olivetoric acid, m.p.  $150-51^\circ$ . The latter is further identified as its tri-acetate

(by the acetic anhydride-pyridine method), m.p.  $80-81^\circ$  (colourless prisms from methanol) soluble in bicarbonate and having a negative ferric reaction. (Found: C, 64.34; H, 6.52;  $C_{32}H_{38}O_{11}$  requires C, 64.21; H, 6.35%.) The occurrence of olivetoric acid in *Ramalina* species is new and possibly rare.

The authors thank Dr. D. D. Awasthi of the Lucknow University for the identification of the lichen samples.

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Waltair,  
March 26, 1962.

### NEW MINERAL SPECIES IN MOSABONI COPPER ORES

DUNN<sup>1</sup> gave a detailed account of sulphide minerals associated with the copper ores of Mosaboni area in Bihar State. He reported pyrite, pyrrhotite, arsenopyrite, pentlandite, millerite, violorite, mineral X and chalcopryrite and according to him the paragenesis of these minerals runs as follows: pyrite pyrrhotite, pentlandite, violorite-millerite and chalcopryrite. While examining in detail the copper ores from same area the author met with two more sulphide minerals namely molybdenite and chalcopryrhotite associated with copper ores. The recognition of their presence is believed to further help our understanding of the paragenetic sequence, chemism<sup>2</sup> and origin of the copper ores of the Mosaboni area.

Molybdenite occurs as minute flakes or grains in pyrite, chalcopryrite and gangue. It is white with pale pinkish tint with perfect cleavages (sometimes bent) and strong pleochroism. Power of reflection is low and the reflectivity values with photometer ocular are as follows: Orange—23; Red—24.5; Green—29. It shows strong anisotropism with four extinctions per revolution of stage with a white pinkish tint to light blue colour. It shows sometimes undulose extinction. Twinning is common and is negative to all reagents. It responds to potassium thiocyanate test. It has been partly replaced by chalcopryrite to varying degrees. Dunn reports a mineral X which possesses all the properties of molybdenite but which did not respond to the chemical tests.

Molybdenum has been detected by spectrochemical methods to be present not only in pyrite, pyrrhotite and chalcopryrite but also in minerals like chlorite, biotite and sericite of the altered wall rock. These facts indicate that

the ore solutions contained molybdenum through all stages of the ore formation.

Chalcopyrrhotite is seen associated with pyrrhotite as needles and is interwoven with pyrrhotite. It is brownish yellow in colour with an excellent polish and an immediate tarnish. The reflection is more intense in air than in oil. Some dark portions are slightly pleochroic and is similar to pyrrhotite. Some grains show very weak anisotropism which might be due to variable composition (Brochert).<sup>3</sup> It is highly tarnished with all chemical reagents. The copper content in pyrrhotite varies from 0.16 to 9.7%.

The peculiar association of chalcopyrrhotite with pyrrhotite and the absence of chalcopyrite in and around its margins indicate a high temperature of formation or where extraordinarily rapid cooling might have taken place freezing the spontaneous development of decomposition products—chalcopyrite and pyrrhotite. In either case the temperature of formation is about 240° C. (Brochert).<sup>4</sup>

In the light of these observations and his other studies on the Mosaboni ores the author proposes the following paragenetic sequence of the sulphide minerals in the Mosaboni deposits, arsenopyrite-pyrite, pyrrhotite-pentlandite, chalcopyrrhotite, molybdenite, pyrite of second generation, molybdenite of second generation, and chalcopyrite.

The author desires to express his grateful thanks to the late Prof. C. Mahadevan for his keen interest in the work.

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#### SECRETORY ACTIVITY IN THE INTER-MEDIATE LOBE OF THE PITUITARY GLAND IN THE GARDEN LIZARD, *CALOTES VERSICOLOR*

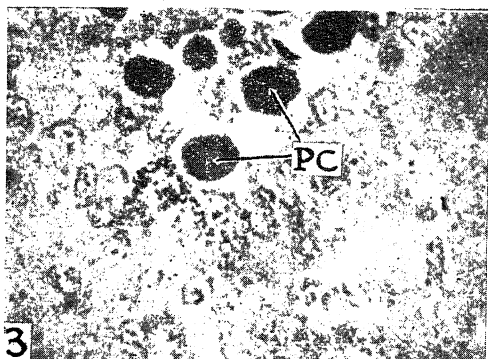
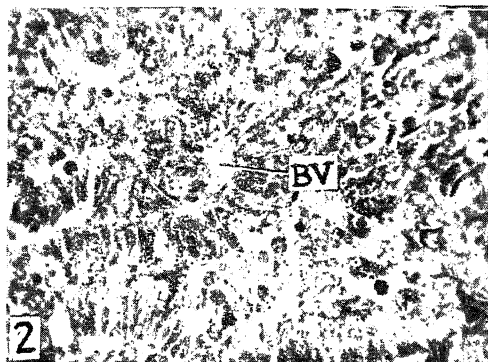
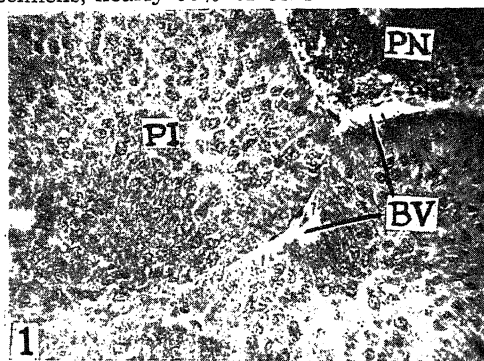
THE current view is that among the factors which influence and control integumentary colour changes in vertebrates one of the most important is the hormone produced by the pituitary gland.<sup>1</sup> It has been stated that the hormone is elaborated by the pars intermedia of the pituitary gland and that it has a direct melanocyte stimulating action. This conclusion has been arrived at chiefly through observa-

tions based on hypophysectomy and injections of pituitary extracts into normal as well as hypophysectomised animals.<sup>2,3</sup> There is very little evidence, however, of direct observations of secretory function of the pars intermedia except those of Scharrer<sup>4</sup> and Altland<sup>5</sup> who observed scanty acidophilic granules in the gland. The following is a preliminary report on work designed to correlate secretory activity of the pars intermedia with integumentary colour changes.

Adult garden lizards of both sexes, collected in the months of August and September, were divided into two groups. One batch was left in glass containers in the laboratory, and the second batch, in darkened glass containers. This was to ensure a variable light incidence on the first (control) group and a constant light incidence on the 2nd (experimental) group. The animals were thus confined for periods up to eight days. They were killed and the pituitary glands were sectioned and stained by Gomori's chromealum-haematoxylin phloxin method.

The pars intermedia is made up of cords of cells which are folded around digitations of the pars nervosa and are separated from the latter by the marginal blood vessels. Branches from these blood vessels pass between the cell cords and form a rich interlacing network in the pars intermedia. The cells of the pars intermedia are long and columnar, with their nuclei situated at one pole towards the centre of the cord and the long cell body extending peripherally, their flat ends resting on the capillaries in a palisade-like pattern. Towards the centre of the cord the cells are smaller, and clusters of nuclei with little cytoplasm are seen. The nuclei are round or oval with well defined chromatin and nucleoli which are well stained and often double. Cytoplasm is usually agranular, and takes up a blue stain (Fig. 1). Occasionally cells may be seen containing phloxinophilic granules and droplets in the cytoplasm. Such cells are few and far between in the normal animal. In the experimental group, the most remarkable feature is a very large increase in the phloxinophilic colloid, both in the intra and extra cellular locations (Figs. 2 and 3). Here the cells become globular, the colloid droplets surround the nucleus, and fill the cell. The droplets later fuse to form large red masses which are often larger than the nuclei and ultimately seem to get extruded from the cell, thus accumulating in the central part of the cord, and pushing the cell and nuclei to the periphery.

The amount of colloid and the number of cells containing them increase proportionately with the duration of the experiment till in 6-7 days specimens, nearly 80% of cells show the colloid.



FIGS. 1-3. Fig. 1. Pars intermedia-control animal, Chrome-alum hæmatoxylin phloxin (CHP) method,  $\times 570$ . Fig. 2. Animal confined in dark glass container for 8 days (CHP) method,  $\times 570$ . Fig. 3. Same as Fig. 2,  $\times 1,140$ .

PI, Pars intermedia; PN, Pars nervosa; BV, Blood vessel. PC, Phloxinophilic Colloid.

Thus it is seen that while animals exposed to natural variations of light conditions incidental to the laboratory show very little accumulation of stainable colloid, those which are exposed to constant colour background (dark glass containers) show a marked increase in

the colloid accumulation both inside and outside the cell. There is also a marked increase in the number of cells showing the changes. When the animals are kept in black surroundings they pass into a phase of integumentary colour and thereafter remain in this phase unless subjected to extraneous stressful stimuli. This produces a stagnation of the hormone, visualised as the colloid accumulation in the pars intermedia.

It seems reasonable to conclude from the above that the experimental condition produces a blocking of the need for colour change which results in an accumulation of the phloxinophilic colloid and that there is a direct correlation between active integumentary colour changes and the stainable colloid in the pars intermedia of *Calotes versicolor*.

Further work in the field is in progress.

We are greatly indebted to Dr. C. M. Francis and Dr. K. K. Nayar, for their critical suggestions, and to Dr. M. Thangavelu, Principal, Medical College, for facilities given.

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#### A NEW DILUTING FLUID FOR ERYTHROCYTE COUNTS IN VETERINARY PRACTICE

HAYEM (1878), Toisson (1917), Gowers (1924) and Tompkins (1948) have formulated different diluting fluids for the enumeration of erythrocytes, but none of them is perfect and all are defective in one way or other. The mercuric chloride in the Hayem's fluid precipitates plasma proteins (Ch'u and Forkner, 1937-38) resulting in clumping of the cells (*vide* Fig. 1). This clumping, especially in the case of sheep and goats, in which the red blood cells are small makes counting very difficult, if not impossible. Tompkins remedied this defect by adding gelatin to Hayem's fluid but this does not remove the distortion of red cells caused by the Hayem's fluid (Fig. 1).

Toisson's fluid is defective in that it allows the growth of bacteria and moulds, causes distortion of cells, requires a long time for the complete settling of the red cells in the counting chamber and is greasy and so makes it difficult



for the pipettes to be quickly and effectively cleaned.

Gowers' fluid, though good in all respects, produces clumping of sheep's blood cells and so makes counting difficult.

the growth of moulds. Further, the red cells settle in the counting chamber in the least possible time. Counts made with this fluid agree with those made by Coulter Counter.

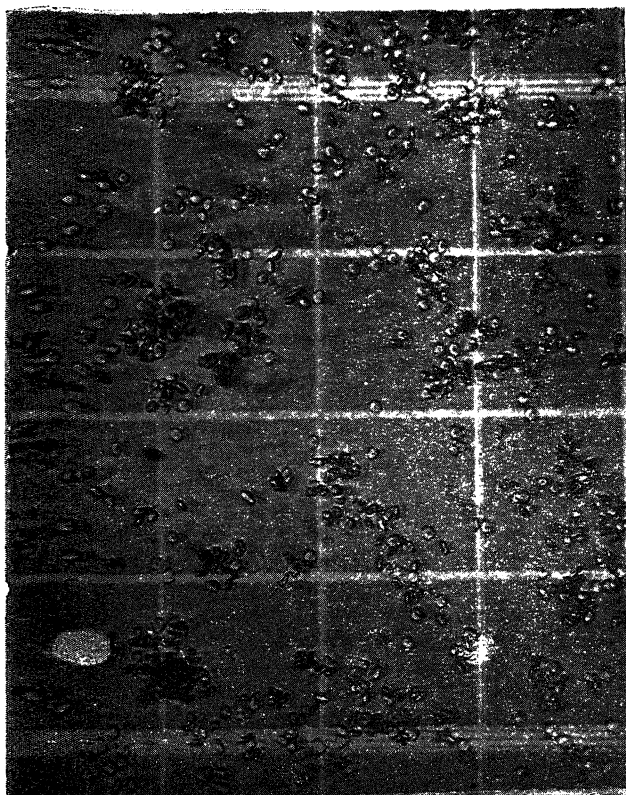


FIG. 1

In an effort to find an ideal diluting fluid, the formula of Vallarino (1941) was modified as follows :

Iodum	0.3 gm.
Potassium iodide	0.4 gm.
Sodium citrate	2.0 gm.
Distilled water	100.0 ml.

Though one gram of sodium citrate would suffice in the above fluid for use with human blood (Vallarino), two grams are required for use with the blood of animals as animal cells being more fragile, laking commences at higher concentrations of sodium citrate than with the human cells. This new fluid stains the corpuscles brown. Moreover, the corpuscles stand out clearly in the counting chamber against a faint yellow background, thus making counting easier. This fluid does not cause clumping of red cells (Fig. 2) nor does it allow

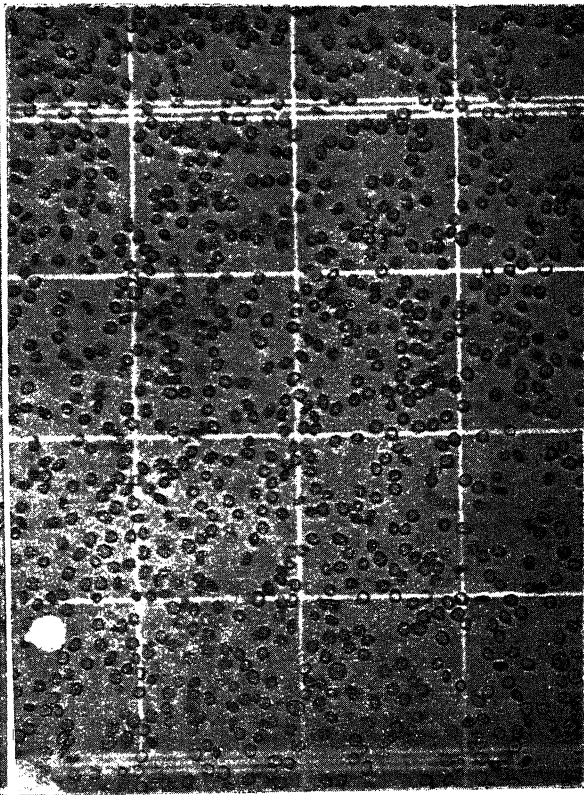


FIG. 2

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### A SOIL TEST PROCEDURE FOR ASSESSMENT OF AVAILABLE NITROGEN IN RICE SOILS

SEVERAL methods have been used for assessing the nitrogen supplying power of soils, and incubation methods of determining the mineralisable nitrogen have shown great promise for practical use.<sup>2,3</sup> The rapid nitrification techniques have shown correlations with crop responses in arable soils but nitrification could hardly be taken as an index of the availability of nitrogen to rice crop which is grown under water-logged conditions. The possibility of using the ammonia release under water-logged conditions as an index of the capacity of soils to supply available nitrogen to rice soils has therefore been studied and compared with other techniques.

18 soils, for which the paddy crop responses in pot culture experiments were available, were incubated at 35°C. under water-logged conditions for one week, two weeks and three weeks separately and  $\text{NH}_4\text{N}$  determined at each stage. The available nitrogen was also estimated in these soils by alkaline permanganate,<sup>2</sup> rapid Iowa nitrification<sup>3</sup> and modified Olsen's method and by determination of percentage organic carbon.

The results show that the coefficient of correlation between the initial ammoniacal nitrogen and the percentage responses worked out to be  $-0.588$  significant at 5% level, thereby showing that the percentage responses are significantly correlated negatively with the initial ammoniacal nitrogen.

The ammonia released after one-week incubation when correlated with the crop responses gave  $-0.783$  coefficient of correlation, which is highly significant at 1% level. The ammonia released after two weeks and three weeks incubation under water-logged conditions however showed poor correlations with crop responses, the correlation coefficient being  $-0.101$  and  $-0.224$  respectively.

From the above data it appears that the release of ammoniacal nitrogen in the initial stages of incubation appears to give a good index of the nitrogen supplying power of soils under water-logged conditions while poor correlations obtained after two weeks and three weeks incubation indicate possibly erratic changes in the nitrogen content due to nitrification and denitrification followed by losses of nitrogen which are known to take place under water-logged conditions.

The correlation coefficients between the % organic carbon ( $-0.444$ ), available nitrogen values as obtained by Iowa nitrification method ( $-0.480$ ) and Olsen's modified method ( $-0.363$ ) and the percentage responses are

comparatively low in these paddy soils. The coefficient of correlation between the available nitrogen by alkaline permanganate method and the crop responses was  $-0.70$  which is significant at 1% level and is next to the one obtained with ammonia release during the first week of incubation.

These results indicate that the ammonia released during one-week incubation under water-logged conditions gives the best index of the capacity of soils to supply nitrogen to rice crop.

Divn. of Soil Science and B. V. SUBBIAH.  
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### A NEW BACTERIAL LEAF-SPOT ON *ALANGIUM LAMARCKII* THW.

A BACTERIAL disease affecting the leaves of *Alangium lamarckii* Thw. has been noticed on the shrubs and small trees growing at the Garda College ground, Navsari, during July 1961. The fruits of these shrubs commonly known as *ankola* (growing extensively throughout India) though astringent and acid are relished and the branches used for making hedges. The wood is hard, tough, close-grained and valuable as fuel. Leaf infection appears as round to irregular brownish spots measuring about 1-5 mm., surrounded by water-soaked area of about 1 mm. The infection also occurs on veins extending up to 20 mm. on either side of the original spot and the interveinal portion of the leaf. Central portion of the leaf-spots when observed against light appears bright red and transparent with occasional cracking. Sometimes when the mid-vein is infected, a typical twisting of the leaf occurs. Minute dark spots outside the water-soaked area are also noticeable in some instances.

Preliminary studies indicated the pathogenic organism belonging to *Xanthomonas*. Since no bacterial pathogen affecting plants in Family *Cornaceae* is reported so far, it is proposed to assign to it a new name *Xanthomonas alangi* Nov. sp. technical description of which is as follows:—

Short rods, usually single, rarely in chains of two, measuring  $1.5 \times 3.6 \mu$ , motile with a polar flagellum, gram-negative, capsulated, non-spore-former, not acid-fast. Colonies on

potato-dextrose agar plates are circular with entire margins, smooth, shining, pulvinate, dull lemon yellow, odourless. Growth on potato-dextrose agar slants is copious, filiform, dull lemon yellow, odourless, convex, smooth, opaque and butyrous, medium unchanged. On nutrient agar slants, growth is moderate, filiform, convex, glistening, smooth, opaque, lemon yellow, odourless, butyrous, medium unchanged. Gelatine liquified; starch hydrolysed; indole not produced; nitrate not reduced; ammonia and  $H_2S$  produced; V.P. - ve; M.R. + ve; citrate utilised but not uric acid. Growth in nutrient broth is fair with pellicle. Litmus milk alkaline with slight peptonisation. Good growth in dextrose and sucrose but none in salicin; optimum temperature for growth 27-29° C. Aerobic. Thermal death point is 52° C.

Producing leaf-spots on *Alangium lamarckii* only. Found at Navsari, Gujarat State.

Fuller details will be published elsewhere.

We gratefully acknowledge the valuable help of Professor W. V. Kotasthane.

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### SEED TESTING

#### IV. Effects of toxic substances from *Palak sag* (*Beta vulgaris* L.) seeds on the germination of Gram and Paddy

WATER-EXTRACT of toxic substances in Beet seeds has been found to depress germination in oats (Duym *et al.*, 1947). In *Palak sag* (*Beta vulgaris* L.) which belongs to the same species as the common beet, the nature of the toxic substances has been found to be somewhat different from that of beet (Mukherji and Basu, 1961). The nature and mode of hindrance to germination was taken up in the present investigation.

1,000 *palak sag* seeds were soaked in 200 ml. of distilled water for 24 hours in a stoppered glass bottle. The water extract, which was yellowish brown in colour, was applied to petridishes on which germination tests were carried out for gram (*Cicer arietinum*) and paddy (*Oryza sativa*) on filter-paper substratum, in replicated lots, adopting the procedure prescribed under the International rules for seed testing (1953). Observations on growth and number of germinated seeds were made at 24-hour intervals. Some of the results are given in Table I.

TABLE I

Treatment	Germination P.C.	Gram			Germination P.C.	Paddy		
		Length (cm.)		Number of Roots		Length (cm.)		Number of Roots
		Shoot	Root			Shoot	Root	
Control ..	70	5.02	3.30	1.73	100	5.89	3.80	27.80
Treated ..	30	1.23	2.50	Nil	100	4.42	2.03	9.70

Differences are all significant at 5% p.c. level.

In both gram and paddy, germination was completed within 72 hours. As the seedlings of the treated sets of gram were found to become brown and gradually die out after 72 hours, the shoot and root growth data were obtained after 72 hours in gram and after 168 hours in paddy. In the latter the seedlings of the treated sets remained alive even after this period. The germination percentage of gram is much lower than in paddy though the speed of germination was apparently much slower in the treated sets than in the controls in both. After germination, the seedlings of gram in the treated sets become brownish after 72 hours and gradually die out within 7 days, but in paddy, the seedlings did not die but their roots became granular and rough showing tendency towards brittleness, and root hairs did not also form. In paddy, the root growth is somewhat more affected than the shoot growth.

The harmful effect of seed extract of beet on germination of oats seed, has been explained (Duym, 1947, *loc. cit.*) on the basis of osmotic pressure theory. It appears that the inhibitory effects of the toxic substances manifest more on root growth in case of paddy, but as the seedlings grow older, the effects gradually disappear. The husk of paddy may interfere, to some extent, the entry of the poison to affect the germ readily. In case of gram, however, the possible easy entry of the toxic substance in solution, through the micropylar end of the seed, causes poisoning of the germ and the effects are manifested even in germination. The browning and ultimate death of the seedlings in gram, treated with water-extract of *palak sag* seeds, may be adduced to the release of ammonia by organic nitrogenous compounds during germination, as in the case of beet seeds (Stout and Tolman, 1941; U.S.D.A., 1952). The poisonous effects of *palak sag* seed extract on germination of other seeds suggest that suitable precautions should be taken to guard against any possible contamination of germination

equipment when any other kind of seed is tested simultaneously with *palak sag* seeds at the Seed Testing Laboratory.

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### AN INHIBITOR FOR PETIOLATE CONDITION IN *NICOTIANA* *TABACUM* L.

IN *Nicotiana tabacum*, sessile-leaved types are predominant while petiolate forms are few. Most of the commercial types such as flue-cured, wrapper, cigar, cheroot and chewing, etc., are sessile. The few cases of petiolate types, met with in India, are *Lanka*, an indigenous cheroot tobacco of Andhra, *Jati*, a fine chewing tobacco of Bengal, and some hookah types in Punjab. The known cases of petiolate condition were either under dominant monogenic control

or under complementary action of genes.<sup>1-5</sup> During our study to know the nature of petiolate condition in crosses between unrelated types in the collection maintained at the Central Tobacco Research Institute, Rajahmundry, a case was met with (N.P. 68 × Turkish sessile), where petiolate leaf base was apparently recessive to the sessile condition. The inheritance of this character is presented in this paper. Data are also reported in this study of another cross where a lanceolate petiolate type, *Lanka*, was crossed with a heart-shaped petiolate type, *Jati*, to study the inheritance of leaf shape between two petiolate types where the complications arising from sessile condition giving rise to different leaf shapes were not met with.

N.P. 68 is a petiolate type from the collection of Indian tobaccos maintained at the Indian Agricultural Research Institute, New Delhi. It resembles *Lanka* in many respects. Turkish sessile is a small, sessile-leaved Turkish type. The  $F_1$  between these two was definitely sessile. The crosses of Turkish sessile with other petiolate types known to carry dominant genes for petiolate leaf base, e.g., *Jati*, and *Lanka*, were suggestive that the Turkish type carried an inhibitor for petiolate condition. In the cross *Lanka* and *Jati*, the  $F_1$  was petiolate and lanceolate. The relevant data for both these crosses are presented in Tables I and II.

In the cross N.P. 68 × Turkish sessile, the  $F_2$  and backcross data indicated monogenic differ-

TABLE I  
Segregation of  $F_2$  and backcross of N.P. 68 × Turkish (sessile) for petiolate condition

Generation and Ratio	Observed		Expected		Total	$X^2$	P
	Petiolate	Sessile	Petiolate	Sessile			
N.P. 68 ..	Petiolate	..	..	..	..	..	..
Turkish (sessile) ..	..	Sessile	..	..	..	..	..
$F_1$ N.P. 68 × Turkish (sessile) ..	..	do.	..	..	..	..	..
$F_2$ (1 : 3) ..	68	198	66.5	199.5	266	0.0451	0.80-0.90
$F_1$ × N.P. 68 (1 : 1) ..	125	101	113.0	113.0	226	2.5487	0.10-0.20
$F_1$ × Turkish (sessile) ..	0	155	0	155	155	..	..

TABLE II  
Segregation of leaf shape in  $F_2$  and backcrosses of *Lanka* × *Jati*

Generation and Ratio	Observed		Expected		Total	$X^2$	P
	Lanceolate	Heart-shaped	Lanceolate	Heart-shaped			
<i>Lanka</i> × <i>Jati</i>							
$F_2$ (3 : 1) ..	83	31	85.5	28.5	114	0.2924	0.50-0.70
$F_1$ × <i>Lanka</i> (2 : 0) ..	301	0	301.0	0	301	..	..
$F_1$ × <i>Jati</i> (1 : 1) ..	27	25	26	26	52	0.0769	0.70-0.80

ence between the parents for this character. Since *Lanka* is known to carry the dominant gene  $P_2$  for petiolate condition, the segregation indicated that the Turkish sessile type carried a dominant inhibitor in addition to the  $P_2$  gene.

In the cross between *Lanka* and *Jati*, there was no segregation for petiolate condition showing that both were isogenic for petiolate condition. As regards leaf shape, the lanceolate shape of *Lanka* was dominant over the heart shape of *Jati*. The  $F_2$  and backcross to *Jati* indicated a single gene difference for leaf shape in this cross in contrast to the complicated hypotheses postulated by other workers where the epistatic and other effects of genes controlling leaf base and auricle development made the phenotypic classification very difficult.<sup>3,5</sup> The gene is designated Lh-lh.

The wide prevalence of sessile types in *Nicotiana tabacum* is probably due to (a) presence of inhibitory factors for petiolate condition, (b) the necessity of the combination of three dominant genes responsible for petiolate condition in the case of complementary gene action, and (c) selection by man for greater surface of lamina. The data of Brieger and Forster<sup>6</sup> also fits with the inhibitory factor hypothesis suggested in our study. Among the postulated progenitors of *N. tabacum*, *N. sylvestris* is sessile-leaved. In the section *Tomentosae*, which contains the other parent of *tabacum*, none has such distinct petiole without wing as in some forms in *N. tabacum*. Therefore, it is possible that the petiolate types in *N. tabacum* are due to the complementary action of the gene systems from the two parental species. In amphidiploid, the new gene combinations, not present in the original parents, tend to increase in their frequencies in the populations, if they have some bearing on the fitness of the new species. Petiolate condition in plants is intended to permit maximum exposure of the lamina to sunlight. However, the cultivation of *N. tabacum* is under wide spacing which permits ample supply of sunlight. Thus the petiolate types do not appear to have any specific advantage over the sessile types. However, it is likely that the natives of U.S.A. had selected lines for maximum leaf area which naturally eliminated petiolate types.

Central Tobacco Res. B. S. KADAM.\*

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#### STEM ANATOMY OF SOME NYCTAGINACEAE

THE structure of the node of *Boerhaavia diffusa* L. has already been described in detail by the present authors.<sup>1,2</sup> A paper on the structure of the node of *Mirabilis jalapa* L. is under publication elsewhere and the study of the nodal structure of some others is almost complete.

All these studies are based mainly on serial microtome sections of a large number of nodes and internodes of each form from the youngest to the very old ones which have numerous rings of vascular bundles and therefore due stress has been laid on anatomical variations in individual nodes. The nodes of all investigated forms have been found to be unilacunar as already pointed out by Sinnott and Bailey.<sup>3</sup> A peculiar feature of these plants is the variable number of leaf trace bundles which can vary even in the two opposite leaves of the same node.

The so-called large medullary bundles in an internode of *B. diffusa*<sup>4</sup> and the main bundles of its apparent middle ring (which are actually the peripherally deflected traces for the leaves of the subsequent node) are traceable downwards to a single inner ring of the underlying node. In each node the two "medullary bundles" widen out appearing like plates of vascular tissue. Their sides become recurved and their curved ends on either side produce the branch traces. Two traces are thus formed for each one of the two opposite branches which arise at slightly different vertical levels. After giving rise to the branch traces the residual "medullary bundles" usually divide into three or four vertical strands (see Fig. 1). Generally, in the upper part of a node each lateral strand out of these branches of a "medullary bundle" fuses with the adjacent lateral strand of the opposite "medullary bundle" and in that manner are formed a pair of decussating "medullary bundles" of the next internode. The remaining median branches of the "medullary bundles" or the fused lateral ones may divide further or as such travel vertically upwards (after deflecting slightly towards the periphery so as to form an apparent middle ring) throughout the next internode. These bundles form the supply of the leaves in the node above. Usually the traces

of each leaf fuse to form a C-shaped arc and then divide just before they enter the base of the petiole. The supply of the one or more accessory branches in the axil of each leaf and of the extra-axillary branch (inflorescence stalk) is derived from the branch traces. The bundles of the belated ring usually form one or more connections with the leaf traces and the branch traces so that a really complex plexus is formed in each node.

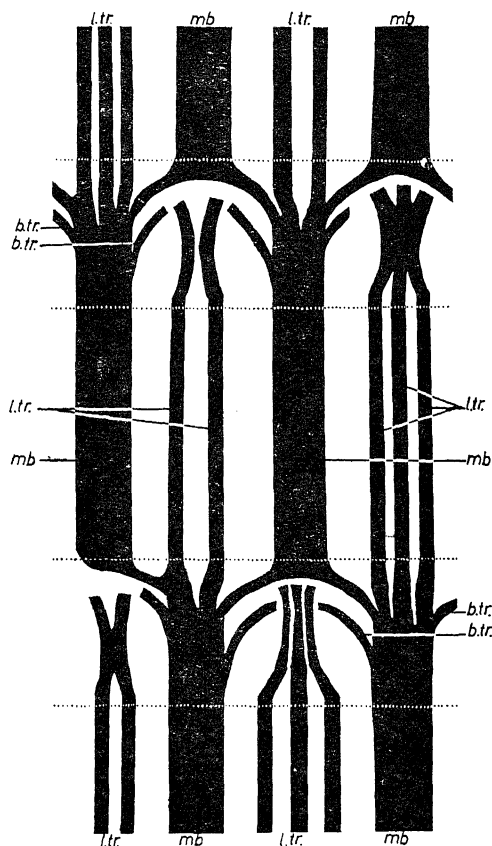


FIG. 1. Diagrammatic reconstruction of the longitudinal course of vascular bundles of *B. diffusa* stem in the inner ring as flattened out in one plane. The accessory branch traces, "middle ring" strands other than leaf traces and belated ring bundles are not shown to avoid complication. The length and thickness of the bundles is by no means proportional to their actual dimensions. Dotted lines indicate the approximate boundaries between nodes and internodes.

*b.tr.*, branch trace; *l.tr.*, leaf trace; *mb*, "medullary bundle".

The stem structure of *M. jalapa* is similar but its inner ring typically shows eight bundles (six leaf traces and two somewhat larger central strands). Surrounding these are some intermediate strands and one or more peripheral

rings of vascular bundles and conjunctive tissue. The role of central strands in *M. jalapa* is similar to that of the "medullary bundles" of *B. diffusa* and they follow a decussating sequence in successive internodes (see Fig. 2). Each leaf

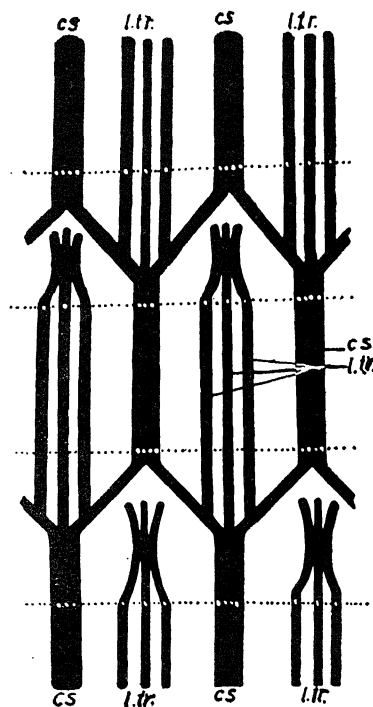


FIG. 2. Diagrammatic reconstruction of the longitudinal course of vascular bundles of *M. jalapa* stem in the inner ring as flattened out in one plane. The traces for the various branches, intermediate bundles and peripheral ring strands have not been shown to avoid complication. The length and thickness of bundles is not drawn proportional to their actual dimensions. Dotted lines indicate the approximate boundaries between nodes and internodes. *cs*, central strand; *l.tr.*, leaf trace.

of *M. jalapa* is invariably supplied by three inner ring bundles supplemented by a variable number of outer strands. The maximum number of leaf traces in *M. jalapa* is usually considerably higher than that in *B. diffusa*. In *M. jalapa* all of them invariably fuse before entering the base of the petiole. This complex nodal plexus formed by fusions and divisions of inner ring bundles, intermediate strands, peripheral ring bundles and the large number of leaf traces is further complicated by the strands which supply the axillary, abaxial accessory and adaxial accessory branches. These branch bundles are connected with the central strands but their supply is also augmented by branches from other outer strands.

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### CRITICAL CONCENTRATION OF NITROGEN IN THE MEDIUM AS A DETERMINING FACTOR FOR FORMA- TION OF HETEROCYSTS IN MYXOPHYCEAE

ABUNDANCE of heterocysts in *Anabaena cylindrica* Lemm. has been shown by Fogg<sup>1</sup> to be inversely related to the concentration of combined nitrogen in the cells and that the supply of nitrogen in the form of ammonium salts reduced their numbers. Mitra<sup>2</sup> observed total absence of heterocysts in *Tolypothrix arenophila* W et G.S. West (= *Camptylonema lahorensis* Ghose) when grown in De's<sup>3</sup> medium containing potassium nitrate. Recently, Pandey and Mitra<sup>4</sup> have shown that in the latter alga presence of more than .02 gm. of potassium nitrate per litre of medium totally inhibited the formation of heterocysts, while wide variations of temperature, light intensity and pH of the medium did not give comparable results. This idea of critical concentration of nitrogen in the medium for production of heterocysts was tested with pure cultures of *Scytonema pragnans* Skuja, *Anabaenopsis ambigua* Pandey et Mitra and *Fischerella muscicola* (Thur.) Gom. The basal medium used was that of De's<sup>3</sup> and only quantities yielding equivalent amounts of nitrogen from each source were taken. The cultures were grown in 100 ml. medium (pH 7.0) in 250 ml. flasks at  $20 \pm 2^\circ \text{C}$ . under a light intensity of 600 lux from a battery of 100 watt electric lamps. Residual nitrogen in the media was determined by micro-Kjeldahl method (except in the case of ammonium sulphate which was determined with the help of a photo-electric colorimeter). The sizes of inocula were nearly uniform (being taken with an 'inoculum cutter'). Experiments were run in triplicate and the mean results obtained are shown in Table I.

From these results it is obvious that: (1) with nitrates as the source of nitrogen there exists for all the organisms tested a sort of critical concentration of nitrogen in the medium

TABLE I

Showing average concentrations of residual nitrogen at the time of heterocyst-production, expressed in mg./100 ml. of medium, in the three species of Myxophyceae

Organisms	Nitrogen sources			
	Potassium nitrate	Magnesium nitrate	Ammonium nitrate	Ammonium sulphate
1 <i>Scytonema pragnans</i> Skuja	35.70	37.80	29.75	18.00
2 <i>Fischerella muscicola</i> (Thur.) Gom.	21.70	23.10	17.20	12.00
3 <i>Anabaenopsis ambigua</i> Pandey et Mitra	18.25	18.20	15.10	9.60

above which heterocysts are not produced. This varies with different algæ. (2) With ammonium salts the figures for the critical concentration of nitrogen for production of heterocysts varied not only with the species but also with the nature of the compound. In the present experiment the maximum concentration of nitrogen given as ammonium sulphate which is necessary for the production of heterocysts is less than that of ammonium nitrate and both these compounds show lower values when compared with nitrates.

It appears, however, that different Myxophyceae require different maximum amount of nitrogen beyond which heterocysts are not produced. The relation of this fact with growth phases of algæ (cf. Fogg<sup>1</sup>) is not clear at present since growth may continue vigorously in a medium containing less than this concentration of nitrogen with extensive heterocyst formation or as in *Anabaenopsis ambigua* Pandey et Mitra akinetes may be abundantly produced yet there will be no trace of heterocysts if the nitrogen level in the medium remains above the limit for heterocyst production. The latter fact also points to dissimilarity between the nature of the akinetes and heterocysts as otherwise these could be expected to respond to similar nitrogen status of the medium.

Presence or absence of heterocysts have been employed for generic distinction between several Myxophyceae such as *Plectonema* and *Scytonema*, *Pseudanabaena* and *Anabaena*, *Homoeothrix* and *Calothrix* and several others. Lack of heterocysts in the genera and species belonging to heterocystous groups needs further investigation (cf. Fritsch,<sup>5</sup> Demeter,<sup>6</sup> Drews<sup>7</sup>) in the light of the results obtained from this investigation. It may be reported here that we have just obtained two species of *Anabaena* growing vigorously in



a heterocystless condition and these can easily be taken for *Pseudanabæna*.

The authors are indebted to the C.S.I.R., India, for financial assistance.

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#### A NOTE ON AN ABNORMALITY IN THE CONJUGATION OF *SPIROGYRA* *PUNCTULATA* JAO

THE object of this communication is to report an abnormality in the conjugation of *Spirogyra punctulata* Jao<sup>4,5</sup> collected from a freshwater puddle along the G.T. Road, Karnal District, Punjab, during August 1958.

Vegetative cells 76–83.6  $\mu$  broad and 98.8–152 (–304)  $\mu$  long with plane and walls; filaments usually curved; chloroplast 3–7, making  $\frac{1}{2}$  to  $1\frac{1}{2}$  turns; conjugation scalariform, conjugation tubes formed by both gametangia; fertile cells cylindric; zygospores ellipsoid with pointed ends, 68.4–76  $\mu$  broad and 121.6–138.6  $\mu$  long; median spore wall thick, finely punctate and yellow at maturity.

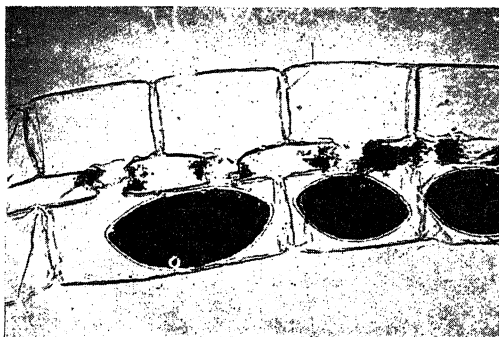


FIG. 1. Abnormal conjugation in *Spirogyra punctulata* Jao.

In normal scalariform conjugation, one conjugation tube is formed by each gametangium, resulting in the fusion of one male gamete with a single female gamete. In some abnormal cases, two male gametangia were found to conjugate with one female gametangium (Fig. 1).

In such cases each male gametangium puts forth a conjugation tube while the female gametangium puts forth two conjugation tubes. This results in the fusion of three protoplasts, and the resulting zygospore is a triploid. The term triploid here refers to the fact that more than three protoplasts fuse. The actual chromosome number could not be determined as these observations were made on preserved material. Such naturally formed triploid zygospores provide interesting material for genetic study of these organisms, and will contribute to the understanding of the polyploid series in these organisms. In *Spirogyra varians* and *S. lacustris*, the filaments formed from such triploid zygospores did not morphologically differ from the normal ones.<sup>3</sup>

Similar cases of abnormalities in the conjugation have been reported in many species of *Spirogyra*,<sup>1–3,6</sup> *Zygenema*,<sup>3</sup> *Mougeotia* and *Desmids*.<sup>4</sup>

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#### A NOTE ON THE VEGETATIVE PROPAGATION OF MEDICINAL PLANTS

THE note records the effect of Indole acetic acid (IAA), Indole butyric acid (IBA) and Alpha-naphthalene acetic acid (NAA) on rooting of soft wood cuttings from *Helicteres isora* L., *Marorophali* and *Nerium odorum* L. Kanel.

The chemicals were used in three concentrations, 25, 50 and 75 p.p.m. The dip technique of treatment was employed—the duration of the dip being 6, 9 and 12 hours. 75 cuttings of uniform size were used for each treatment. The cuttings after treatment were washed with water and planted in pots filled with sand (pH 7.7). Controls were run by dipping cuttings in water only. All the experiments were conducted during the months of July–August.



TABLE I  
Relative effectiveness of IAA, IBA and NAA on rooting of *Marophali* and *Nerium*  
Period of Expt. 15-7-1961 to 18-8-1961

Plants	Harmones	Growth substances concentration in parts per million	No. of cuttings and duration			Percentage of success			Rooting time in days*				
			6	9	12	6	9	12	6	9	12		
Marorphali	..	IAA	25	75	75	75	60	56	54	30	31	34	
			50	75	75	75	55	54	51	28	28	29	
			75	75	75	75	53	52	50	25	26	26	
		IBA	25	75	75	75	62	62	60	28	31	31	
			50	75	75	75	58	55	52	27	28	28	
			75	75	75	75	55	54	50	25	25	27	
		NAA	25	75	75	75	68	64	62	23	24	28	
			50	75	75	75	64	63	60	25	28	30	
			75	75	75	75	56	55	52	25	28	31	
	Control		..	..	75	..	..	46	..	..	34	..	
	Nerium	..	IAA	25	75	75	75	92	86	82	28	30	31
				50	75	75	75	90	82	80	27	28	29
75				75	75	75	86	82	80	27	28	31	
		IBA	25	75	75	75	93	90	87	26	28	28	
			50	75	75	75	92	90	86	27	28	30	
			75	75	75	75	90	88	82	29	29	30	
		NAA	25	75	75	75	96	94	90	25	25	26	
			50	75	75	75	95	92	88	25	27	28	
			75	75	75	75	93	90	86	27	28	29	
Control		..	..	75	..	..	68	..	..	34	..		

\* Mean rootings time 20% of cuttings, selected in a randomized manner.

Table I summarises the results. These indicate: (a) the duration of the dip is most effective at 6 hours; (b) a concentration of 25 p.p.m. is more effective than either 50 or 75 p.p.m. and (c) NAA is more potent than either IBA or IAA for the two species under the experimental conditions.

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#### OCCURRENCE OF EXEMBRYONATE SEEDS IN THE UMBELLIFERAE<sup>1</sup>

THE causes of the frequent high percentage of exembryonate seeds in six umbelliferous species have been investigated. Dissections of mature seeds of *Anethum graveolens* L., *Coriandrum sativum* L., *Cuminum cyminum* L., *Daucus carota* L., *Foeniculum vulgare* Mill. and *Trachyspermum ammi* (L.) Sprague, revealed the presence of a phytophagous chalcid fly, *Systole albipennis* Walk, of the family Eurytomidae (Fig. 1). Apparently the fly inserts the ovipositor through the fruit wall and lays an egg

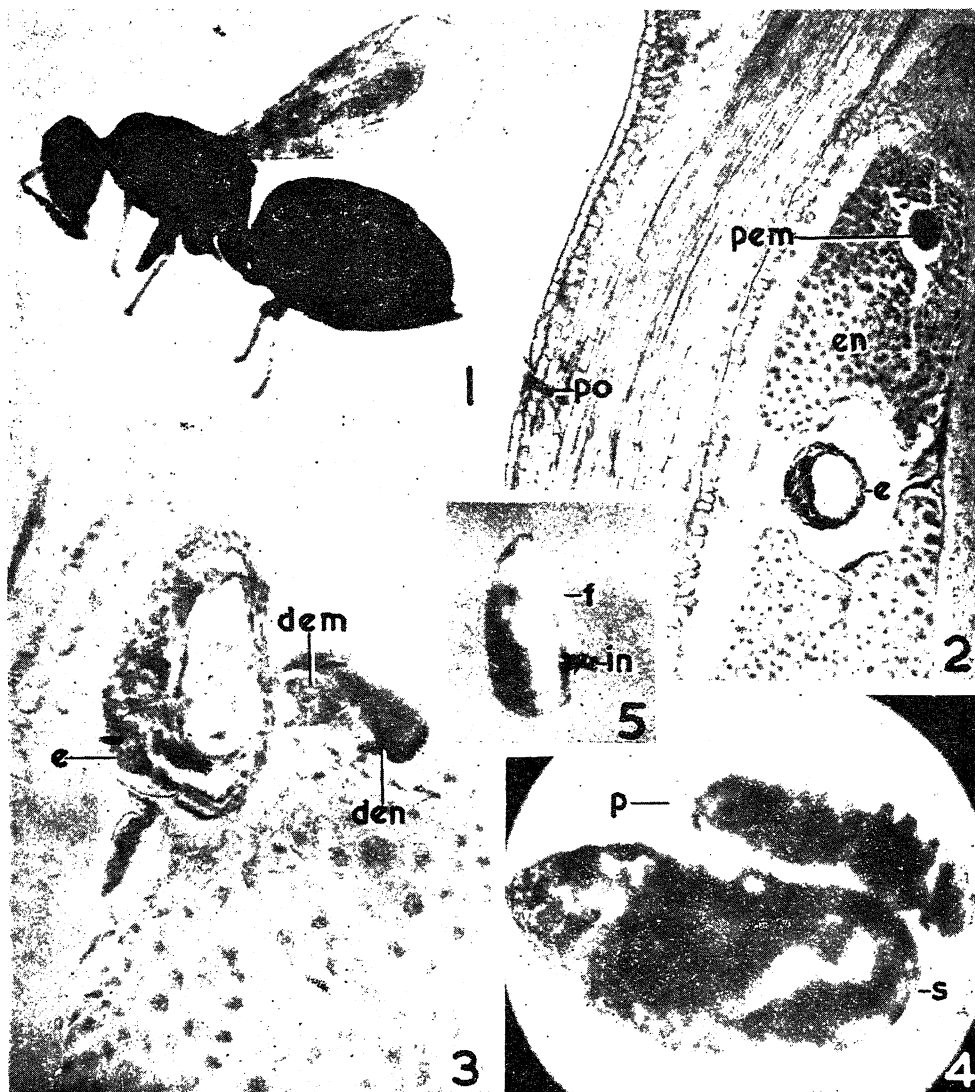
between the pericarp and the ovule. At this stage the mericarp contains partially or completely cellular endosperm and a filamentous or globular proembryo. Dissected fruits showed several developmental stages of *Systole*. This was also confirmed from microtome sections which revealed that concurrently with the growth of the ovary, endosperm and embryo, the chalcid egg hatches and the larva developing from it feeds upon and destroys the embryo and/or endosperm (Figs. 2 and 3). Consequently, approximately 40% of the mericarps of *Foeniculum*, 35% of *Daucus*, 30% of *Coriandrum*, 27% of *Anethum*, 20% of *Cuminum* and 10% of *Trachyspermum* lack the embryo or sometimes even the endosperm. The adult fly bores a hole in the pericarp and escapes. These insects infect fresh mericarps and thereby increase the percentage of exembryonate seeds during the late season.

The mericarps often also disclosed the egg or larva of a parasitic insect, either *Tetrastichus* (fam. Eulophidae) or *Liodontomerus* (fam. Torymidae). In the early developmental stages the *Systole* and the parasite usually lie adpressed

to each other (Fig. 4). The parasites grow at the expense of *Systole* without destroying the embryo or the endosperm except that some damage may be caused due to spatial relationships. Whether this biological control can be adopted to save the umbelliferous crops requires further study.

nutrient medium. After 10-15 days *Systole* (Fig. 5) or *Tetrastichus* emerged from some of the mericarps and survived in the culture tube for 11-17 days.

Besides *Systole* some species of *Lygus* also severely damage various umbelliferous fruits<sup>2,3</sup> and during feeding they pierce many cells and



FIGS. 1-5. Fig. 1. *Systole albipennis*, adult,  $\times 22$ . Fig. 2. *Foeniculum vulgare*, l.s. immature mericarp showing proembryo (*pem*), cellular endosperm (*en*) and developing insect (*e*); note the path of ovipositor (*po*),  $\times 100$ . Fig. 3. Same, later stage showing insect larva (*e*) and damaged proembryo (*dem*) and endosperm (*den*),  $\times 250$ . Fig. 4. One of the parasites (*p*) lying adpressed to the larva of *Systole* (*s*),  $\times 35$ . Fig. 5. Fifteen-day-old culture of fennel fruit (*f*) showing emergence of *Systole* (*in*),  $\times 4$ .

To trap the adult insects, fertilized ovaries of *Anethum*, *Daucus*, *Foeniculum* and *Trachyspermum* were cultured on a modified White's

suck the cell fluid.<sup>4</sup> As some of the oral secretion remains in the damaged tissue,<sup>5</sup> it has been postulated that such a material might be phyto-

toxic; however, this has not yet been demonstrated. In the Umbelliferae the endosperm matures more rapidly than the embryo and when *Lygus* feeding occurs at an early stage of seed development both the endosperm and the embryo are destroyed and the seed aborts. Seeds become embryoless if feeding occurs at a later stage of development since the immature embryo is destroyed and the more mature endosperm remains unaffected.<sup>6,7</sup> Such a preference appears non-existent with *Systole* as its larva usually damages both the tissues but upon hatching it begins to consume whichever is in the vicinity, and if only the endosperm is destroyed embryo fails to develop. Exembryonate seeds caused by *Systole* are readily detected by the hole in the pericarp made by the escaping adult, whereas those resulted by *Lygus* feeding cannot be recognised by external inspection.<sup>8</sup>

The present studies with *Systole* are being extended to determine whether deposition of the egg occurs only in the developing mericarp or in other tissues as well. In addition, a survey is under way to estimate the extent of exembryonate seeds produced in the Umbelliferae by the chalcid fly in other regions of the world.

I am indebted to Dr. B. M. Johri and Professor P. Maheshwari (Delhi) for their interest in the work, to Miss F. Flemion (Yonkers, N.Y.) for revising the manuscript, and to Dr. B. D. Burks (Washington) and Dr. J. F. Perkins (London) for identifying the insects. Thanks are due to the Indian Council of Agricultural Research, New Delhi, for financial assistance.

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# CHROMOSOME NUMBER OF *CORCHORUS PASCUORUM* DOMIN, A WILD JUTE OF AUSTRALIA (FAMILY : TILIACEAE)

THE genus *Corchorus* has several wild species distributed in the tropics and the subtropics of the world. Only two species, *C. olitorius* L. and *C. capsularis* L., are economic plants yielding bast fibres known as jute. Chromosome numbers of these and a few other wild species were reported from time to time.

This wild species is endemic occurring on heavy grey clay open grass land in North-Western Queensland, Australia. Seeds were collected by Dr. F. Ward in August 1961, from Julia Creek.

Chromosome number is found to be 28 (Fig. 1) and is reported for the first time. It seems to be a natural polyploid like *Corchorus siliquosus* Linn. (Rao and Datta, 1953).

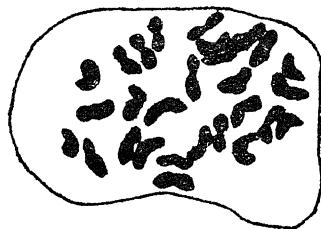


FIG 1. Somatic metaphase plate showing 28 chromosomes,  $\times 800$ .

Seeds were first treated in conc.  $H_2SO_4$  for half an hour, thoroughly washed and kept overnight on moist blotting-papers in petri dishes. When thoroughly soaked with water, testa was split open to hasten germination as no seeds germinated previously after acid treatment. After a day or two healthy roots came out. Root tips were pre-treated with 0.02 M Oxyquinoline for two hours at 8–9° C. and then fixed in acetic-alcohol (1:2) for about half an hour. Then they were transferred to  $NHCl + 2\%$  aceto-orcin (1:9) for one hour and warmed later for a few seconds. Ultimately they were squashed in 1% aceto-orcin. This method proved successful.

The author expresses his grateful thanks to Sri. R. M. Datta for his advice and to Dr. S. L. Everest, Government Botanist, Botanic Museum and Herbarium, Botanic Gardens, Brisbane, Australia, for kindly sending seeds.

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# SOME CYTOLOGICAL STUDIES ON TWO SPECIES OF *CUNNINGHAMELLA* —THE CHONDRIOME AND NUCLEI

MEVES<sup>1</sup> defined the term "Chondriome" as the entire mitochondrial contents of a cell. Recently Hackett<sup>2</sup> has described the mitochondria as delicate, fragile and morphologically heterogeneous particles (spheres, rods and threads) capable of undergoing quick changes due to slight variations in the experimental conditions. So far only limited studies have been made on the chondriosomes and nuclei of Mucorales.<sup>1,2,5-7</sup>

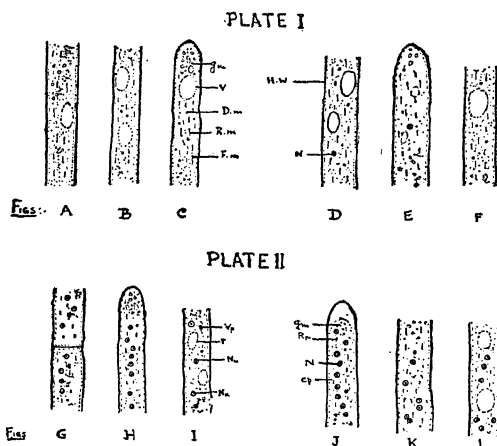


PLATE I Figs. A, B and C Showing different types of mitochondria found in *Cunninghamella echinulata* Thaxter. Figs. D, E and F. Showing nuclei in resting stage of *Cunninghamella echinulata* Thaxter. V, vacuole; H.W., hyphal wall; N, nucleus; D.m., disc-shaped mitochondria; R.m., Rod-shaped mitochondria; F.m., filamentous mitochondria. Figs. G, H and I. Showing mitochondria in *Cunninghamella bertholletiae* Stadel. Figs. J, K and L. Showing nuclei in resting stage of *C. bertholletiae* Stadel. PLATE II, Vp, Vacuolar precipitates; V, Vacuole; N, Nucleus; Nu, Nucleolus; N.m., Nuclear membrane; R.m., Rod-shaped mitochondria; C, Cytoplasm.

The present two species of *Cunninghamella*, viz., *C. echinulata* Thaxter and *C. bertholletiae* Stadel, were isolated from the soil sample collected from Agriculture Farm of the Allahabad University. Vegetative mycelium was studied both under living and fixed conditions. The following four fixatives were used. Helly's liquid, Helly's liquid (with sodium sulphate), sublime formol and liquid of Lenhossek. The techniques used were similar to those employed by Saksena,<sup>8</sup> and Saksena and Bose.<sup>9</sup> Supravital staining of the mitochondria was done with Janus green Höcht B and neutral red mixed with Janus green Höcht B. For nuclear studies the material was fixed between 12-30 p.m. and

1 p.m. Raper's fixative, Flemming's fluid (strong) and Flemming's weak solution (modified by Saksena) were used as fixatives. Details of the technique were similar as used by Saksena and Bhargava.<sup>10</sup>

Observations under living condition showed that actively growing mycelium of both the species had minute rounded shining bodies which were moving rapidly in the cytoplasm. These bodies gave characteristic reaction of fats. Along with these there were seen disc-like and rod-shaped mitochondria lying mostly parallel to the longitudinal axis of hyphae (vide Plate I). The mitochondria moved freely in the cytoplasm. In the tips of hyphae these structures were usually in the form of granules which could be easily distinguished from fat particles in being smaller in size, sluggish in movement and lesser in refrigence. Behind the tips, the mitochondria were rod-shaped somewhat filamentous in structure and were seen fragmenting vide Plate II. In supravital staining better results were given by combining the two stains, viz., Janus green Höcht B and neutral red, mitochondria took up sky blue colour while the vacuoles were stained brick red. In the fixed material best results were obtained with Helly's liquid and sublime formol.

Raper's fixative and Flemming's weak solution (modified by Saksena) gave best results for fixing the nuclei which were found scattered in the cytoplasm throughout the hyphae. Deeply stained, rounded nucleolus was also distinguished in the centre of the nucleus, which was surrounded by a nuclear membrane (vide Figs. D, E, F of Plate I and J, K, L of Plate II).

The authors are thankful to Dr. K. S. Bilgrami, Assistant Professor in Botany Department, Allahabad University, for his valuable help.

Botany Department, R. K. SAKSENA.  
Univ. of Allahabad (India), A. K. SARBHOY.  
November 8, 1961.

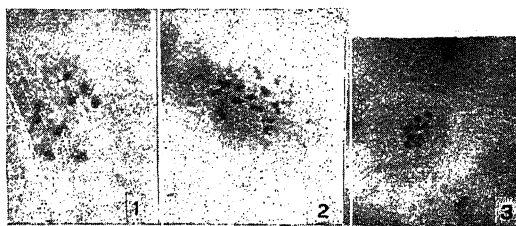
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CHROMOSOME NUMBERS IN SOME  
COMPOSITAE

THE family Compositae is well represented in India by several species distributed among 120 genera. Much cytological work has been done in this family. However, several plants yet remain to be investigated. The present study deals with two genera of this family.

I. *Launaea* CASS.

The genus *Launaea* Cass. belongs to the tribe Cichorieae and is represented in India by four species. Of these, *L. nudicaulis* Hook. is very common especially in the Konkan and Gujerat region, whereas *L. pinnatifida* Cass. is found only along the sandy coastal regions where it serves as a sand binder along with other plants. This species is distinct from the other ones by its long slender stem which bears the leaves, roots at the nodes and arches between them. The heads are homogamous in *Launaea* all corollas being ligulate. In these parts *L. nudicaulis* is found in plenty almost everywhere, whereas *L. pinnatifida* were collected from Cambay coast and the coast of Okha. *L. glomerata* Hook. was collected from Dwaraka where the plants are available in plenty. Chromosome number has been reported for *L. nudicaulis*<sup>1</sup> but not yet for *L. pinnatifida* and for *L. glomerata*. So it was thought desirable to determine the chromosome number and the nature of the somatic as well as the meiotic chromosomes of the remaining species.



FIGS. 1-3. Fig. 1. M I of *Launaea glomerata*. Fig. 2. Somatic chromosomes<sup>2</sup> of *L. pinnatifida*. Fig. 3. M I of *Eclipta prostrata* var. *alba*.

The buds were fixed on the spot in acetic alcohol. Keeping the heads of the appropriate size for 20 to 30 minutes in water at a low temperature (13-15° C.) prior to fixation showed active divisions at times when divisions are normally not frequent. Stem tips for somatic studies were pretreated with 0.2% colchicine or 8-hydroxyquinoline before fixation. Very young leaves were also employed to determine the somatic number. These also were treated like the stem tips, i.e., prefixation in colchicine or

8-hydroxyquinoline and fixation in acetic alcohol, followed by usual feulgen squashes, after appropriate hydrolysis.

The species which are being worked out are *L. pinnatifida*, *L. nudicaulis* and *L. glomerata*. All of them showed nine bivalents in their pollen mother cells. The somatic counts from the leaf tips and stem tips showed 18 chromosomes, confirming the meiotic counts. Almost all somatic chromosomes are characterised by median constriction. *L. nudicaulis*, however, showed the presence of chromosome bridges especially in the first division of meiosis.

The species of *Launaea* listed above resemble each other closely in their external morphology. Cytologically also they show identity as regards chromosome number and morphology. It is expected that a detailed study, which is in progress, may reveal the cytological basis for the morphological differences between the three species. Perhaps, in the speciation of this genus, structural changes, rather than number and morphology of the chromosome have played a significant role.

II. *Eclipta* LINN.

*Eclipta* Linn. belongs to the tribe Heliantheae and is fairly well distributed throughout India by *E. prostrata*, *E. prostrata* var. *alba* and *E. prostrata* var. *erecta*. These were formerly believed to be separate species but now it is considered that these are varieties of the same species, *E. prostrata*.

The chromosome number of *E. prostrata* var. *erecta* is reported to be  $2n=22$  by Singh.<sup>2</sup> All the three varieties have now been worked out from materials collected from this locality. All of them showed the same chromosome number. The pollen mother cells showed 11 bivalents and the root tips and the stem tips showed 22 chromosomes. Somatic chromosome morphology did not reveal any variation between the varieties.

The work is being done under the guidance of Prof. T. S. Raghavan to whom we are deeply indebted.

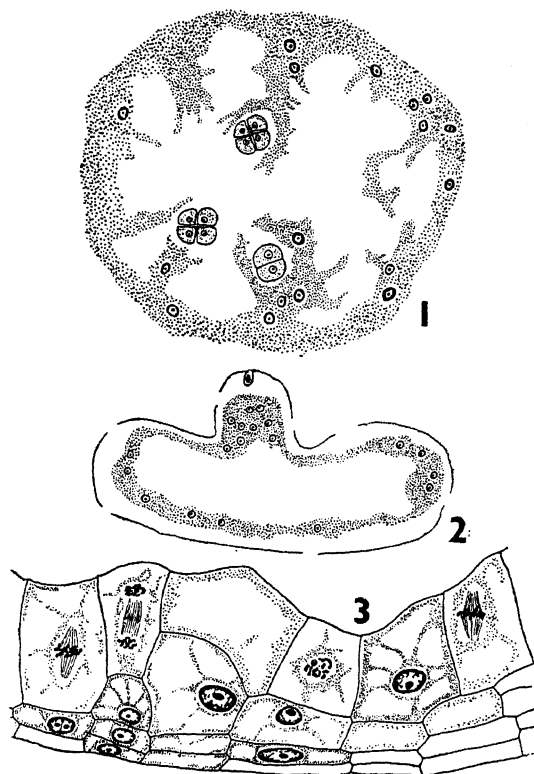
Dept. of Botany,  
Sardar Vallabhai  
Vidyapeeth,  
Vallabh Vidyanagar,  
October 24, 1961.

K. V. JITENDRA MOHAN.  
MISS P. GIRIJA.  
A. O. N. PANIKKAR.

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# EMBRYOLOGICAL FEATURES OF *POLLIA SORZOGONENSIS*, ENDL

THE published embryological literature on the family Commelinaceæ has been recently summarized by Maheshwari and Baldev (1958). The embryological features of *Pollia sorzogonensis*, Endl are presented here with a view to supplement the available information. The taxon was collected from the forests of Poringalkuthu, Kerala.



FIGS. 1-3. Fig. 1. Periplasmodium, tetrads of microspores,  $\times 950$ . Fig. 2. Nuclear endosperm depicting the micropylar collar zone and the lower chalazal part. Zygote in division,  $\times 160$ . Fig. 3. Part of the cellular endosperm; the nuclei in various stages of division,  $\times 950$ .

Sections of young anther show the outermost epidermal layer, and two or three subepidermal layers derived from the primary parietal layer. The outer of these mature into the fibrous endohegium; the innermost layer consisting of uninucleate cells develops into a true periplasmodium (Fig. 1). The microspores divide in a successive manner and the subsequent developments of the microspores present no deviation from the norm. They become two-celled and monosulcate at the shedding stage.

The ortho-campylotropous ovule is bitegmic, crassinucellate, and the micropyle is formed by both the integuments. The single hypodermal archesporial cell cuts off a parietal cell and this in turn divides a couple of times so as to give rise to a parietal tissue. The megaspore mother cell, after meiosis, forms a linear tetrad of megaspores; often the micropylar dyad cell fails to divide and thus, only three cells may represent the tetrad stage. The chalazal megaspore develops into a 8-nucleate embryo-sac.

After fertilization the ovule changes its shape due to the predominance of growth in the chalazal part. Thus, it becomes distinguishable into a small micropylar collar zone and a large chalazal part. The embryo-sac also conforms to similar changes in surface area. The divisions of the primary endosperm nucleus are all free nuclear and the nuclei become disposed along the periphery. At this stage, there is a tendency for the accumulation of a larger number of nuclei per unit area in the collar zone (Fig. 2). Formations of cell-walls between the free endosperm nuclei commence from the micropylar end and after this process is completed, the endosperm cell in the chalazal part undergo periclinal divisions at a faster rate and present the appearance of a meristematic tissue in so far as the arrangement of the cells are concerned (Fig. 3). Such a method of division causes the growth of endosperm centripetally, thereby obliterating the cavity. During this process if the rate of caryokinesis is not promptly accompanied by cytokinesis, binucleate endosperm cells are formed. In the fully formed endosperm, the shape, size and the number of nucleoli of the nucleus varies with the region of the endosperm. In the mature condition the endosperm cells become filled with starch grains.

Prior to fertilization, the outer integument consists of four and the inner of two layers of cells. All but the innermost layer of the outer integument disintegrates during successive stages of development. The radial walls of this layer become heavily thickened which phenomenon spreads to the inner tangential walls. Of the two layers of the inner integument, the outer one develops thickenings and both the layers constitute part of the seed coat.

I express my indebtedness to Prof. B. G. L. Swamy, for guidance and for the preserved material.

Department of Botany, K. K. LAKSHMANAN.  
Presidency College,  
Madras-5, December 16, 1961.

**SELF-INCOMPATIBILITY IN MANGO  
(*MANGIFERA INDICA* L.) VAR.  
DASHEHARI**

ALTHOUGH self-incompatibility is known to occur in a number of fruit crops, it has not been reported in mango so far. During the course of hybridization work 676 flowers were selfed in the variety Dashehari with a view to study the variations in the progeny of this variety. However, none of these selfed flowers developed

judging setting in mango. Further, self-incompatibility, if established in some more mango varieties, will necessitate the planting of suitable pollinisers in mango orchards. At the same time it will facilitate mango hybridization work. Mango breeder will actually be equipped with a nature-given tool which will aid him to produce mango hybrids in large numbers.

The authors are grateful to Dr. B. P. Pal, Director, Indian Agricultural Research Institute,

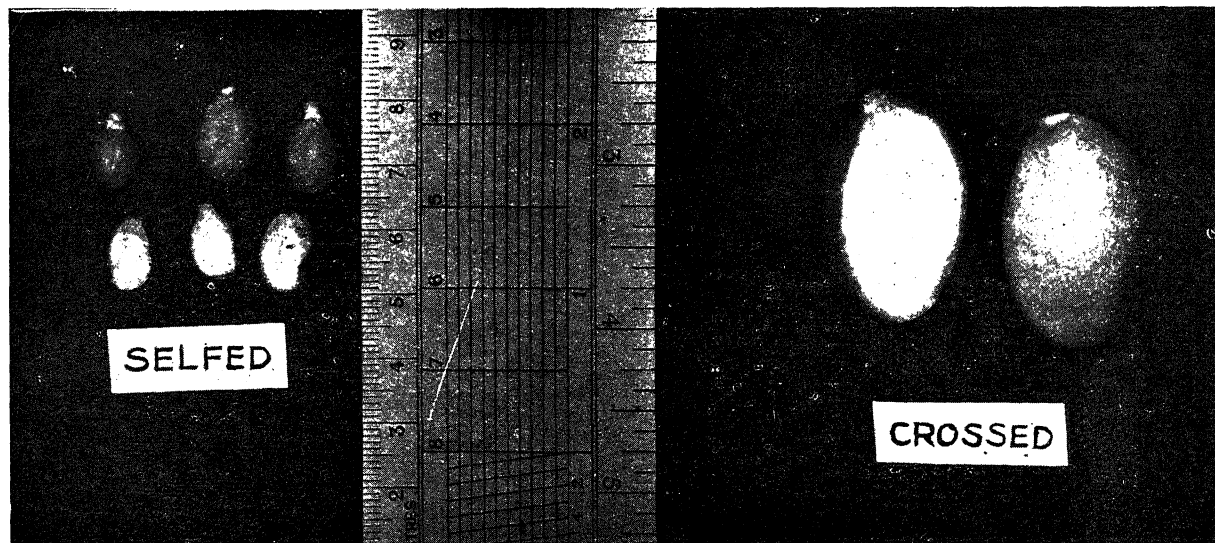


FIG. 1

beyond pea stage. Ovaries of the open-pollinated flowers of the same age and on the same tree showed considerably higher rate of growth. The same was true regarding the crossed flowers pollinated on the same date as the selfed ones. After one month of pollination, there was appreciable difference in the size of the developing selfed and crossed fruits. The average length and diameter observed in case of selfed fruits was 1.1 cm. and 0.6 cm. respectively while in case of crossed or open-pollinated fruits it was 3.7 cm. and 1.8 cm. respectively.

The selfed "fruitlets" turned yellow, almost ceased to grow and ultimately dropped down. These were then dissected and found to contain tiny, shrivelled and empty ovules which were creamy white or dark black in colour. On the other hand, the ovules in the open-pollinated fruits of the same age were healthy and of normal size (Fig. 1).

It appears that in the present case, mango ovary is capable of developing up to pea stage without the actual fertilization of the ovule. In that case one needs to go beyond pea stage for

and Dr. S. K. Mukherjee, Head of the Division of Horticulture, for the facilities and encouragement.

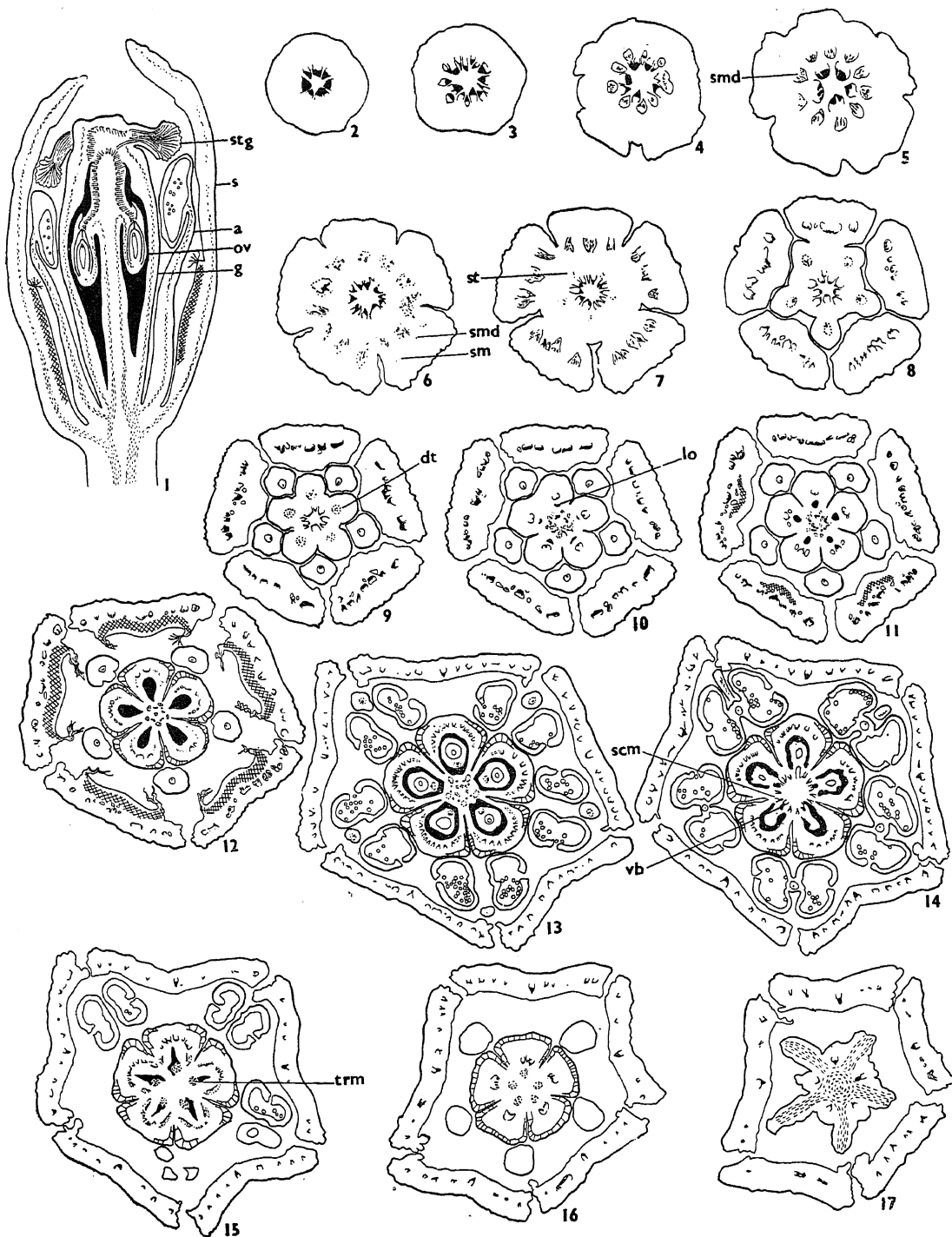
Division of Horticulture,  
I.A.R.I., New Delhi-12,  
October 26, 1961.

R. N. SINGH.  
P. K. MAJUMDAR.  
D. K. SHARMA.

**FLORAL ANATOMY OF *SEETZENIA*  
*ORIENTALIS* DECNE.**

THE work on floral anatomy of the Zygophyllaceae is meagre. Saunders (1937) studied the vascular anatomy of *Zygophyllum fabago*, *Tribulus terrestris*, *Peganum harmala* and *Guaiaacum officinale* from the point of view of carpel polymorphism. Recently Nair and Nathawat (1958) worked on the floral anatomy of *Tribulus terrestris*, *T. alatus*, *Fagonia arabica*, *F. mollis*, *Peganum harmala*, *Zygophyllum dumusum*, *Z. simplex* and *Nitraria retusa*. However, a similar account of *Seetzenia*, a monotypic Afro-Asian genus, differs from those previously studied in certain respects.

The stele in the pedicel is a broken cylinder of eight conjoint collateral bundles with thin medullary rays (Fig. 2). The calyx supply is



FIGS. 1-17. Fig. 1. L.S. of the flower-bud,  $\times 16$ . Figs. 2-17. T.S. of the same from the base to the top in series at different levels,  $\times 21$ . a, stamen; dt, dorsal trace; g, gynœcium; lo, locule; ov, ovule; s, sepal; scm, secondary marginal; smd, sepal midrib; st, staminal trace; stg, stigma; trm, transmitting tissue; vb, ventral bundle.



of ten traces (Figs. 3-5). Five of these form the sepal midribs while the other five which alternate with the former divide to form the marginals of the adjacent sepals (Fig. 6). Thus, the traces of the sepal are strictly receptacular as in *Nitraria* and are neither commissural as in *Fagonia*, nor derived from petal strands as seen in *Zygophyllum*, *Peganum* and *Tribulus* (Nair and Nathawat, 1958). Both the marginal and the midrib bundles branch so that the sepal ultimately receives more than five traces (Figs. 7-8). The stele reorganises immediately after the departure of the sepal traces and gives off five staminal traces alternating with the sepals (Figs. 7-8). The petals and the inner whorl of stamens are totally absent and are not even represented by the vascular stubs in the receptacle. There is no bilobed scale or gland at the foot of the filament as in *Zygophyllum* and *Tribulus* nor a receptacular disc.

The vascular traces for the carpels consist of dorsals, secondary marginals and ventrals (Figs. 9-14). The dorsals branch frequently supplying the abaxial side of the carpels (Figs. 9-12). The secondary marginals originate independently from the central stele (Figs. 12-13) and hence are not commissural with dorsals as in *Tribulus* and *Fagonia*. The ventrals are in dorsal radii (Fig. 14). The carpels are lobed in the region of the ovary. At the angular sides of each lobe the epidermal cells are bloated and secretory with dense content. This condition extends up to the tip (Figs. 12-16).

There are in all five ovules, one in each locule on axile placenta. They are bitegmic and anatropous. Only one trace supplies each ovule (Figs. 1, 12).

Beyond the level of the ovules, the dorsal and secondary marginals of the carpels show anastomosis and get consolidated into five bundles (Figs. 15-16). These do not extend into the five, terminal spreading arms but alternate with them (Figs. 1, 17). Hence, the style is short and the lateral spreading arms are stigmatic though Hooker (1872) describes them as styles. The ventrals are strictly placental in supplying the ovules and have no part in furnishing the stylar supply contrary to the condition seen in *Peganum* and *Fagonia*.

In conclusion the flower of *Seetzenia orientalis* is monochlamydeous, tricyclic, actinomorphic, incomplete, perfect and pentamerous. The free sepals are imbricate. Their traces are receptacular. Both the sepal midrib and the marginals divide to form more than five traces. The petals are absent. There is only one whorl of stamens alternating with the sepals. There are

no indications of suppression of petals and inner whorl of stamens in the form of vestigial strands in the receptacle. There is no semblance of nectariferous disc though Hooker (1872) describes the presence of such a small, five-lobed structure bearing the stamens. Each carpel of the pentacarpellary, syncarpous gynoecium receives a dorsal trace, two secondary marginals and one ventral trace. The placentation is axile bearing one ovule in each locule.

We are deeply grateful to Professor C. V. Subramanian for encouragement.

Dept. of Botany, H. S. NARAYANA.  
Univ. of Rajasthan, C. G. PRAKASA RAO.  
Jodhpur, India, November 23, 1961.

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#### THE ROLE OF NITROGEN IN THE INDUCTION OF THE "BRUSONE" DISEASE OF RICE

THE various rice diseases lead to serious losses, particularly in the countries of the temperate zone.<sup>1</sup> Well known is the so-called brusone disease\* of rice the appearance of which is promoted by some environmental factors, such as excess of nitrogen, cold, cloudy weather, etc. Of the factors promoting disease development the nitrogen supply is of major importance as it greatly influences the growth of vegetative organs and the yield.<sup>2-4</sup>

In field experiments the application of high nitrogen doses [20 q (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>/hectar] revealed interesting relationships between the root growth of different rice varieties and their resistance to brusone. It may be seen from Fig. 1 that the high nitrogen doses affect adversely the root growth of the susceptible variety Dunghan Shali, whereas the development of the root system of the resistant variety Dubowsky-129 was more or less unimpaired.

According to our observations high nitrogen doses result in the appearance of the symptoms of the disease (presence of the fungus *Piricularia oryzae* in the leaves, browning of the nodes, sterility, etc.<sup>5</sup>) shortly after shooting. Under the same circumstances the resistant sort Dubowsky-129 remained healthy (Fig. 2). In

\* Brusone disease is a complex of diseases the chief of which is *P. oryzae*.

the establishment of the fungi we attribute an essential role to the disturbances of the nitrogen metabolism due to the unfavourable conditions as well as to the abnormal increase of certain free amino-acids.

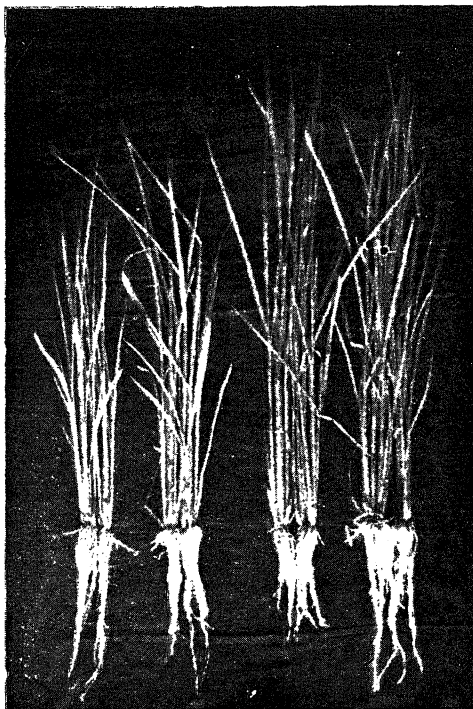


FIG. 1. Effect of large nitrogen doses on the growth of root of different rice sorts. *From left to right*: Dunghan Shali (control), Dubowsky-129 (control), Dunghan Shali (with nitrogen), Dubowsky-129 (with nitrogen).

It is worth mentioning that the disease producing effect of large nitrogen doses highly depends on the soil type and on current weather conditions.

By the time of the appearance of the disease the differences in the development of root system of susceptible and resistant varieties become more and more pronounced (Fig. 2), which is disadvantageous from the point of view of uptake of nutrients and water. Under unfavourable weather conditions, particularly with varieties possessing poorly, horizontally evolved root system, physiological drought might develop in spite of watering. By the time of flowering the physiological drought might result in high degrees of metabolic disturbances, sterility and disease and might lead to serious damage.<sup>6</sup>

It seems safe to conclude that in the temperate zone at least in the case of brusone induced by high nitrogen doses the susceptibility of the rice plant is greatly affected by its

root/shoot ratio. Further studies are needed to show the eventual effect of high nitrogen doses on the metabolism of growth regulators which

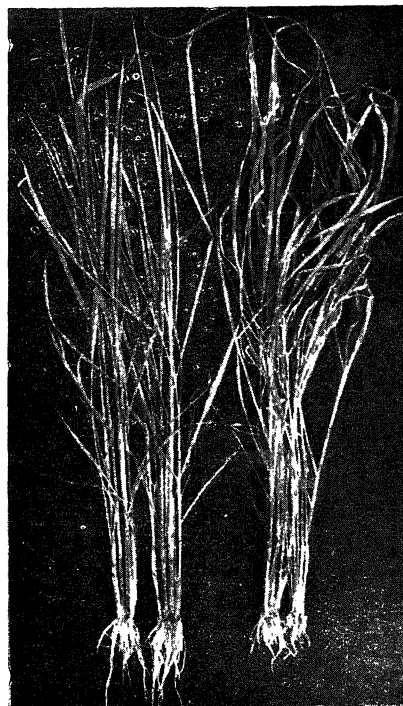


FIG. 2. Brusone disease provoked by large nitrogen doses. *Left*: Dubowsky-129 (healthy). *Right*: Dunghan Shali (diseased in brusone).

may induce the gross changes in the pattern of development.

Institute for Plant

F. ZSOLDOS.

Physiology of the University, R. VAMOS.  
Szeged, Hungary,  
February 12, 1962.

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#### A COMMENT ON THE CYTOGENETICS OF THE INTERGENERIC HYBRID, *VACCARIA GRANDIFLORA* × *SAPONARIA VACCARIA*

I HAVE read with interest the recent paper by Khoshoo and Bhatia<sup>1</sup> in which they have shown on cytogenetical grounds that the species *Saponaria vaccaria* Linn. is a member of the

genus *Vaccaria* Medic. A similar conclusion has been arrived at by some taxonomists and in particular I want to invite the attention of these authors to the recent publication by Bocquet and Baehni.<sup>2</sup> Although the name *Saponaria vaccaria* has been in use since Linne's time, it is quite evident from this work that the plant belongs to the genus *Vaccaria* Medic. According to the Rules of Nomenclature, the correct name for *Saponaria vaccaria* Linn. is *Vaccaria segetalis* (Neck.) Garcke (see Post and Dinsmore<sup>3</sup>). As such the present hybrid is only an interspecific hybrid.

Central National Herbarium, J. K. MAHESHWARI.  
Botanical Survey of India,  
Howrah, November 10, 1961.

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We thank Dr. J. K. Maheshwari for inviting our attention to the recent taxonomical work by Bocquet and Baehni (1959-1961). This work was not known to us when we wrote the above paper. However, we take the opportunity of stating that the name *Saponaria vaccaria* Linn. is still used in floras, research papers and in catalogues of the standard Botanical Gardens;

we feel enumeration of such references is unnecessary.

Botany Department, T. N. KHOSHOO.  
Panjab University, S. K. BHATTIA.  
Chandigarh-3, March 26, 1962.

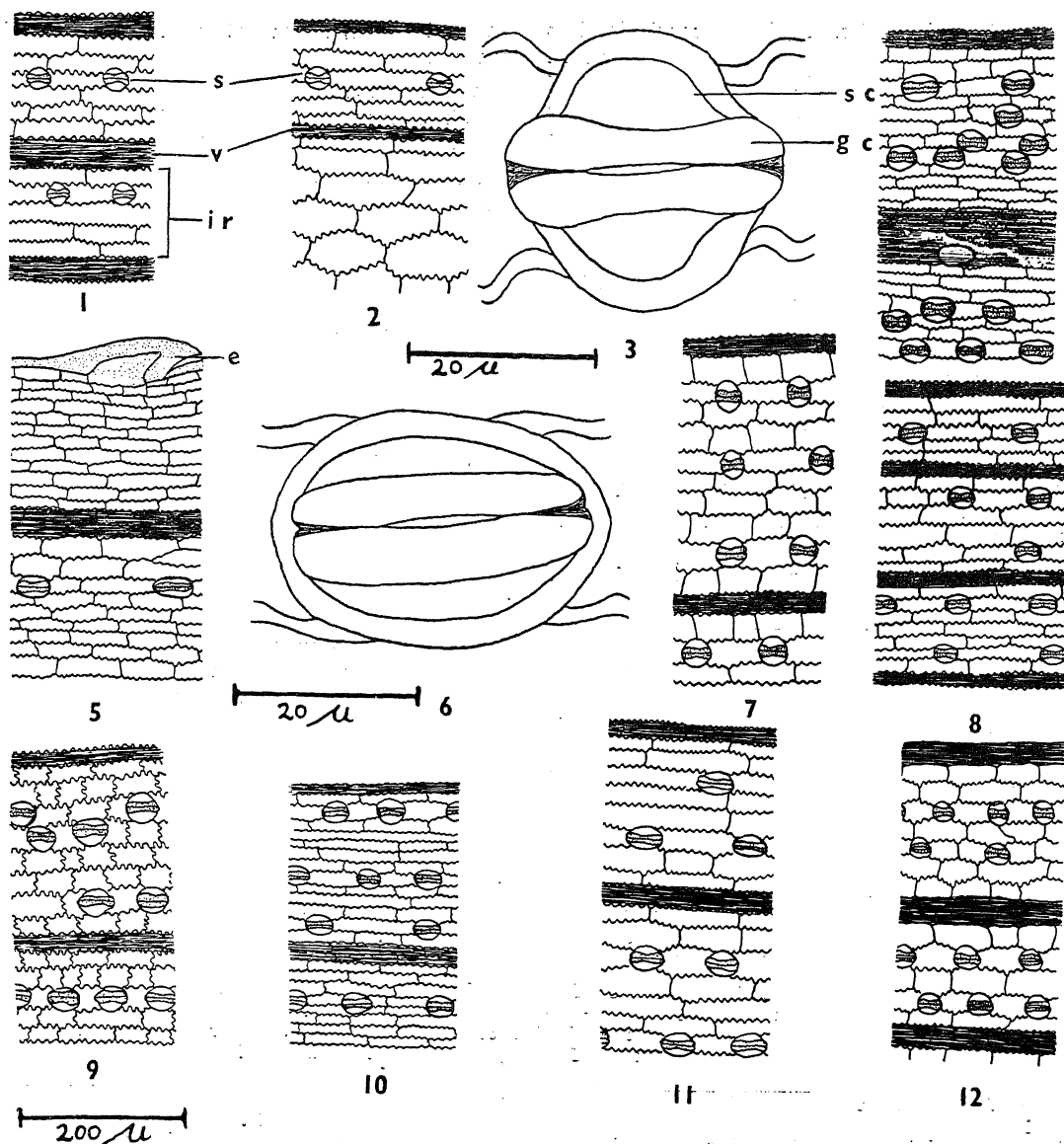
### STUDIES ON THE EPIDERMIS OF SOME MEMBERS OF CYPERACEAE

THE present investigation is on the morphology of the epidermis of some members of Cyperaceae, namely, *Bulbostylis barbata* Kunth., *Cyperus alternifolius* L., *C. aristatus* Rottb., *C. compressus* L., *C. iria* L., *C. rotundus* L., *Fimbristylis dichotoma* Vahl., and *Kyllinga triceps* Rottb. Epidermal preparations of both the lower and upper leaf surfaces have been made by scraping out the epidermis, followed by staining with safranin and mounting in glycerine.

Typically (Figs. 1 and 2) the epidermis presents (i) veins with closely arranged rectangular cells and (ii) intercostal regions between adjacent veins, also having rectangular cells (often hexagonal on upper epidermis) and bearing stomatal apparatuses in one, or more rows. Cells of the epidermis have undulation longitudinal (rarely transverse; e.g., Fig. 9) walls. In the same species there is a pronounced difference between the epidermis of the lower and upper surfaces of the leaf. The various species investigated differ in their epidermal characters, and the relevant data are summarised in Table I.

TABLE I  
Epidermal characters of some Cyperaceae

Species	Intercostal region		Stomatal apparatus				Remarks
	No. of stomatal rows of cells	No. of non-stomatal rows of cells	Size		Inter-stomatal distance along leaf length ( $\mu$ )	Shape of subsidiary cells	
			Length ( $\mu$ )	Breadth ( $\mu$ )			
<i>Bulbostylis barbata</i> Kunth. (Figs. 1-3)	1	4	43	39	67-116	Rounded (Fig. 3)	..
<i>Cyperus alternifolius</i> L. (Figs. 4-6)	3-4 (alternate rows)	4-8	38	24	35-81	Elongate (Fig. 6)	Hairs present on upper epidermis
<i>Cyperus aristatus</i> Rottb. (Fig. 7)	3-4 (3-4 rows of cells apart)	6-8	42	39	52-75	Rounded	..
<i>Cyperus compressus</i> L. (Fig. 8)	1-2	6-8	32	28	31-279	Elongate	Cells larger in the middle intercostus; hairs present on upper epidermis
<i>Cyperus iria</i> L. (Fig. 9)	..	1-2	81	74	35-231	Rounded	Epidermal cells $\pm$ square shaped
<i>Cyperus rotundus</i> L. (Fig. 10)	3-4 (3-4 rows of cells apart)	6-10	35	28	172-175	do.	Upper epidermis with hairs
<i>Fimbristylis dichotoma</i> Vahl. (Fig. 11)	2 (3 rows of cells apart)	4-6	49	28	18-116	Elongate	Upper epidermis with hairs and without stomata
<i>Kyllinga triceps</i> Rottb. (Fig. 12)	2-3 (irregular distribution)	3-4	35	38	21-199	Rounded	..



FIGS 1-12. Epidermis in a few members of Cyperaceae. Figs. 1-3. *Bulbostylis barbata* (Fig. 1. Lower epidermis; Fig. 2. Upper epidermis; Fig. 3. Stomatal apparatus). FIGS. 4-6. *Cyperus alternifolius* (Fig. 4. Lower epidermis; Fig. 5. Upper epidermis; Fig. 6. Stomatal apparatus). Figs. 7-12. Lower epidermis of *Cyperus aristatus* (Fig. 7); *Cyperus compressus* (Fig. 8); *Cyperus iria* (Fig. 9); *Cyperus rotundus* (Fig. 10); *Fimbristylis dichotoma* (Fig. 11) and *Kyllinga triceps* (Fig. 12). *e*, excrescences; *gc*, guard cells; *ir*, intercostal region; *s*, stomata; *sc*, subsidiary cell; *v*, veins.

The present investigation gives evidence to the importance of epidermis as an important morphological unit in the family Cyperaceae. Apart from generic differences, the specific differences of the epidermis are also apparent, as in the species of *Cyperus*. A detailed investigation of the epidermis of members of Cyperaceae is under way.

I am thankful to Prof. K. N. Kaul, F.L.S., Director, National Botanic Gardens, Lucknow, for his constant encouragement and guidance in these investigations. I am also thankful to Dr. P. K. K. Nair for his help and advice.

Director's Laboratory, (MISS) ARUNA AHUJA,  
National Botanic Gardens,  
Lucknow, March 10, 1962.

## REVIEWS

**Mathematics in Science and Engineering**, Vol. III. (*The Optimal Design of Chemical Reactors*.) By Rutherford Aris (Academic Press, New York and London; India: Asia Publishing House, Bombay-1), 1961. Pp. xi + 191. Price \$ 7.00.

This book is the third in the series of monographs on Mathematics in Science and Engineering under the Editorship of Richard Bellman, the originator of dynamic programming. It treats some of the important problems of chemical reactor engineering from a generalised point of view and shows how the methods of dynamic programming have been applied to the optimization problems of chemical reactor design.

The author has first reviewed the principal notions of dynamic programming and the mathematical models for reactor design followed by detailed treatment of continuous flow stirred tank, multi-bed adiabatic and tubular reactors. The last chapter deals with how optimal operation could be achieved in existing reactors.

The book is very well written. It is concise, clear and easy to follow. It is very valuable to those who have anything to do with chemical reactors and particularly to those chemical engineers who have to design chemical reactors.

N. R. KULLOOR.

**Treatise on Analytical Chemistry**, Part II, Vol. 3. (*Analytical Chemistry of the Elements*.) Edited by I. M. Kolthoff, and P. J. Elving. (Interscience Publishers, 250, Fifth Avenue, New York 1), 1961. Pp. xviii + 380. Price \$ 13.25; Subn. \$ 12.00.

In reviewing Vol. 2 of Part I of this Treatise in these columns (see *Curr. Sci.*, 1961, 30, 396) we mentioned the aims and objects of this publication and its usefulness not only to academic research workers, but also to chemists engaged in industrial laboratories.

As pointed out in that review, Section A, Part II of the Treatise will deal with the analytical chemistry of elements in their inorganic forms.

The publishers have in view the issue of seven or eight volumes in this section taking the elements in the most logical order, namely, that based on the periodic table.

However, in a comprehensive undertaking of this magnitude and procedure which neces-

sarily involves the co-operative efforts of large groups of authors it is to be expected that the time schedule regarding completion of manuscripts may not be strictly adhered to. And to minimise delay in publication it may become necessary for the editors to accommodate such lapses by taking "certain liberties in the arrangement of the individual chapters, including some slight deviations from the periodic table arrangement".

Thus we have in the present volume under review, Part II, Vol. 3, the systematic analytical chemistry of the following elements: Copper; Magnesium; Zinc, Cadmium, Mercury; and Tin. Ten authors, each having rich experience in the field of the particular element he is writing about, have contributed to this volume.

The presentation against each element follows a more or less set pattern. Thus there is a brief account of the occurrence of the element, its production, and its toxicology. This is followed by a description of its analytically important physical and chemical properties. Then there are sections dealing with distinctive features in the sampling materials containing the element, methods of separation and isolation; quantitative determination from its important compounds. Finally there are references for the determination of the element in specific materials, and critically selected laboratory procedures.

A. S. G.

**Monographs in Statistical Physics**, Vol. 2. *Thermodynamics*. By P. T. Landsberg. (Interscience Publishers, 250 Fifth Avenue, New York-1), 1961. Pp. x + 499. Price \$ 14.50.

To the practising mechanical or chemical engineer, thermodynamics is one of the branches of physics that is of great practical importance. This often shrouds the fact that Thermodynamics is perhaps one of the most abstract of sciences. The author of the book under review constantly emphasises this aspect of the subject and explains in detail the importance and significance of thermodynamic concepts and conceptual procedures.

It is necessary to underscore the fact that this is by no means an easy book to study. Indeed the author forewarns the reader that the text is 'suitable for any one who is not deterred by abstract thought'. The nature

of the book may be gauged by the subtitles of Chapter II such as (a) Quasi Static Processes; (b) the 'interior' ( $\gamma$ ) of a set of points  $\beta$ ; (c) The connection between Quasi-static Adiabatic Accessibility and the existence of an Integrating factor  $d'Q$  in a Set  $\gamma$ ; (d) the existence of an Entropy and an Absolute Temperature function, etc.

Briefly stated, the book confines itself to classical non-relativistic thermodynamics and only weakly interacting particles are considered. The relationship between thermodynamics and statistical mechanics is brought out extremely well, and explanations given to clarify conceptual difficulties make delightful reading.

An attractive feature of the book is the large number of problems it contains—a feature that is not so common in books of this type. To the serious student these problems are invaluable as they help him to grasp some of the more difficult points in the text.

This book should find a place in the libraries of Institutions interested in Engineering and Science.

M. R. K. RAO.

**Applied Thermodynamics.** By Stanley H. Branson. (D. Van Norstrand Co., Ltd., 358, Kensington High Street, London W. 14), 1961. Pp. vii + 230. Price: Cloth bound 30 sh.; Paperback 22 s. 6 d.

The book consists of nine chapters. In the first chapter the author defines the various terms that come up in thermodynamic literature with a brief account of the use of partial derivatives. The first law of thermodynamics and the thermodynamic functions, internal energy and enthalpy, have been introduced in the second chapter. Some applications of the first law including calculations of the heat of reaction and heat of solution are also given. The ideas of reversibility and entropy have been introduced in the third chapter with applications mostly for ideal gases.

The pictorial and graphical representation of experimental data such as  $T-v$ ,  $T-s$ ,  $h-T$  and  $h-s$  diagrams of Chapter IV are instructive. In Chapter V the author has discussed the deviation in behaviour of real substances from idealised systems. The theory of corresponding states and Pitzer's extension are well described.

The heat engineering students will be particularly interested in Chapter VI where the author deals with the use of tables and diagrams of thermodynamic properties with reference to flow of compressible fluids through nozzles, refrigeration and gas liquefaction.

Chapter VII contains a discussion on free energy, what is usually called by chemists as free energy ( $U + pV - TS$ ) has been called as Gibbs free energy while ( $U - TS$ ), which is called work function, is called Helmholtz free energy. In Chapter VIII the author formulates the conditions of equilibrium of thermodynamic systems. Choosing distillation as an example the author has shown in Chapter IX, the method of examining a process through thermodynamic properties of a system. This chapter is very helpful particularly for chemical engineers.

All the chapters of the book are well written assuming very little mathematical knowledge on the part of the reader. This indeed is a very welcome feature of the book. Another noteworthy feature is the notes that have been provided for each numerical example. A few more exercises without notes are worth having. The list of references at the end of each chapter is quite up-to-date.

The reviewer would like to point out that the concept of temperature could have been better introduced by formulating the "zeroth law of thermodynamics". The first law could be introduced as the equivalence of heat absorbed and work done in a closed reversible cycle. The ideas of perfect and imperfect differentials as applied in thermodynamics could be elaborated.

The reviewer recommends the book to students of Physical Chemistry and Chemical Technology.

M. R. K. RAO.

**Fourier. Transforms.** By Richard Goldberg, (*Cambridge Tracts in Mathematics and Mathematical Physics*, No. 52) (Cambridge University Press), 1961. Pp. viii + 76. Price 21 sh. net.

This book contains a selection of theorems concerning Fourier Transforms on the real line. Notwithstanding the blurb on the dust jacket, it has much in common with other books on the same subject, notably S. Bochner's *Vorlesungen über Fouriersche Integrale* (1937), T. Carleman's *L'intégrale de Fourier et Questions qui s'y Rattachent* (1944), S. Bochner and K. Chandrasekharan's *Fourier Transforms* (1949), and L. Loomis's *An Introduction to Abstract Harmonic Analysis*. It is not as systematic as any of these other books; its scope is more limited. The  $L_1$ -theory on the real line is covered, including Wiener's theorem on the closure of the set of translates of an  $L_1$ -function, some of its extensions, and its reformulation in terms of maximal ideals. Plancherel's theorem is proved, as well as Bochner's theorem on positive-definite functions. One finds here no

special originality in the treatment of these topics. But within the limits which the author has set himself, he offers a very clear exposition. The book is, therefore, bound to be useful to a certain class of readers.

The formulation of Theorem 10F is obscure.\* The example given in 4C is illuminating. The text is neatly arranged, and the printing is excellent.

K. CHANDRASEKHARAN.

\* *Correction Notice since received from the publisher:—* Page 34: The first sentence in Section 10F (with  $\lambda$  replaced by  $k$ ) was intended to be the first sentence in the proof of 10F. The next two sentences comprise the statement of THEOREM 10F.

**Integral Quadratic Forms.** By G. L. Watson. (*Cambridge Tracts in Mathematics and Mathematical Physics—51*). (Cambridge University Press, London N.W. 1), 1960. Pp. xii + 143. Price 30 sh.

This series is published by the Syndics of the Cambridge University Press, under the General Editorship of Professor P. Hall, F.R.S., and Dr. F. Smithies.

The tract gives a modern, but fairly elementary, account of the theory of quadratic forms with integral coefficients and variables. It assumes on the part of the reader a knowledge of elementary number theory (divisibility, congruence, and primality), and rudiments of matrix algebra. In developing the subject the author uses practically no analysis as elementary methods, according to him, are very powerful. The three problems on quadratic forms which are fundamental are equivalence, decomposition, and the representation of integers. In this tract the author scarcely includes anything that does not bear on the above. The book contains some original results of the author which have not been so far published.

The book with its graded and straightforward approach will pave the way for a deeper understanding of the recent advances in quadratic forms over general rings.

**Six Figure Logarithms, Antilogarithms, and Logarithmic Trigonometrical Functions,** (4th Revised Edn.) By C. Attwood. (Pergamon Press, Headington Hill, Hall, Oxford), 1961. Pp. 139. Price 7 sh. 6 d.

This pocket book of tables has been specially compiled to meet the requirements of designers and other workers who need reliable tables for the solution of practical problems. The six logarithmic trigonometrical functions of an

angle, expressed in degrees and minutes, are printed complete with characteristics on the same page in six columns. In this edition a table of proportional parts for tenths of a minute has been added to meet the current engineering practice of calculation using decimals of a minute.

**Water Hammer in Hydraulics and Wave Surges in Electricity.** By L. Bergeron. (John Wiley & Sons, 440, Park Avenue South, New York-16), 1961. Pp. xxiii + 293. Price \$ 15.00.

This book first written by L. Bergeron in French and since translated to English is one of the outstanding books on the subject of water-hammer phenomena. Eminent scientists like Joukovsky, Alkvi, Gibran, Johnson, etc., have contributed in no small a measure but the graphical method as suggested by L. Bergeron is applicable from a simple system to most complicated systems of conduits. Another notable feature of his method is its application in other branches of mechanics.

The book is written in three parts. The first deals with the detailed method of analysis and the derivation of differential equation. Starting with a simple conduit, the method is extended to two conduits of different diameters connected in series and further extended to any number of conduits. Further the method is extended to multiple pipes and junctions. The formula is further modified taking into consideration the head ion in the conduit, including surge tanks in the system.

The singular property of this method is its completely physical nature and the assumed motion of the observers at wave velocity corresponds to the real phenomenon. This automatically eliminates all errors and omissions.

The second part of the book is the most valuable inasmuch as it gives various applications for the use of the graphical method. Several cases of the application of this method has been explained in detail. Cases of instantaneous closure, uniform closure of  $2L/a$  duration, closure time greater than  $2L/a$ , etc., have been dealt with in great detail. The several curves and graphs provided are very easy to understand and apply.

The graphical method developed by the author is not simply applicable to water hammer in conduits but the author has very ingeniously extended the application to (1) a metallic bar having a cross-section small, with respect to its length, and subjected to a variable longitudinal force, a variable twisting moment; (2) a stretched string subjected to a variable

lateral force and, lastly (3) to a transmission line subjected to a variable voltage. The graphical method as developed by Bergeron is a unique one and the book is a very valuable contribution to the civil, electrical and mechanical engineers. The book, excellently got-up, will prove a very valuable addition to the technical libraries of the world.

K. SEETHARAMIAH.

**Free Radical in Biological Systems.** Editors: M. S. Blois, Jr., H. W. Brown, R. M. Lemmon, R. O. Lindblom and M. Weissbluth. (Academic Press, New York and London, India: Asia Publishing House, Bombay-1), 1961. Pp. xviii + 387. Price \$ 14.50.

After remaining in a state of suspended animation for about thirty years from the time of their discovery by Gomberg (1900), free radicals slowly came to be accepted as intermediates in pyrolytic and photochemical reactions. Their role as catalysts for industrially useful processes like polymerization came to be realized at about the same time. The realization of their importance as intermediates in many biological and chemical oxidations is due to the insight, zeal and industry of Leonor Michaelis. With only simple techniques like potentiometric titrations and magnetic susceptibility measurements, Michaelis established that many oxidations take place by single electron transfer steps. "It seems unlikely that the formation of the semiquinone as an intermediary product reduction is restricted to isolated cases presented in the paper. One may dare to express, as a working hypothesis for further investigations, the following idea: "Quinoid substances may be able to generally form semiquinones" (1931). "It will now be shown that all oxidations of organic molecules, although they are bivalent, proceed in two successive steps, the intermediate being a free radical" (1946).

With the development of electron spin resonance spectroscopy, a powerful tool became available to physicists, biologists and chemists for the study of free radicals. The question "..... do free radicals *really* occur in biological systems", heard about a decade ago, will no longer be asked. The quest is for learning the conditions and mechanisms of their formation, methods of propagation and termination, and elucidation of their physico-chemical properties.

The book under review is a collection of twenty-nine original papers and review articles presented at the Symposium on Free Radicals in Biological Systems held at Stanford University during March 21-23, 1960. The purpose of the

conference was to bring together professionally diverse scientists who are actively conducting research in free radicals and to take a stock of this field. It is the opinion of the reviewer that the book not only records history but makes it. Scientific libraries and research workers interested in free radicals and in biological reactions will find the book useful. The value of the book would have been considerably enhanced by inclusion of discussion of the papers.

M. V. BHATT.

**Protein Structure.** By H. A. Scheraga. (Academic Press, New York and London; India: Asia Publishing House, Bombay-1), 1961. Pp. xi + 305. Price \$ 8.00.

This volume—the first of a series of publications on molecular biology—is intended to present some of the quantitative aspects of the physico-chemical approach to problems of protein structure. The physical properties of protein molecules in solution, hydrogen bonding and acid-base dissociations, denaturation behaviour, aggregation, and the problem of limited proteolysis are covered adequately. The chapter on "some experimental methods" covers applications of optical rotation methods, of deuterium-hydrogen exchange and of infra-red and of ultra-violet difference spectra. Considerable stress is laid on evaluation of the secondary and tertiary structures of proteins. Much of the data is drawn from the author's researches, and the application of some of the methods to the study of insulin, lysozyme and ribonuclease is well illustrated in the concluding chapter. The meaning of ultra-violet difference spectra in relation to tyrosine-carboxylate bonds in proteins is discussed extensively. However, there is a growing body of evidence indicating that while UV difference spectra may essentially be related to changes in secondary or tertiary structure of a protein, carboxylate groups may not be the hydrogen bond acceptors for the tyrosine residues or that if tyrosine-carboxylate bonds exist they are broken more as a consequence of molecular expansion than by pH changes as such, and that changes in polarizability of the chromophore environment may exercise a decisive role in the observed spectral changes.

The preface to the book carries the warning that no encyclopaedic coverage of the literature has been attempted. Over four hundred references are cited, and the author's original contributions are fully represented. The book is relatively free of errors, and it provides a



good introduction to the hydrodynamic behaviour of protein molecules and on their secondary and tertiary structure. L. K. RAMACHANDRAN.

P. S. SARMA.

**Sexuality and the Genetics of Bacteria.** By Francois Jacob and Elie L. Woliman. (Academic Press, London and New York; India: Asia Publishing House, Bombay-1), 1961. Pp. xv + 374. Price \$ 10.00.

Although to the biologist of the 19th century bacteria appeared as the most primitive expressions of cellular organisation, "the very limit of life without any recognized sexual reproduction", interest in microbial genetics has witnessed great progress during the past few years of the present century. In this monograph, the authors have attempted to summarize with remarkable facility and considerable success "our present knowledge concerning the process of sexual conjugation in bacteria and its use as a genetic system for investigations of problems of cellular genetics". Some consideration has also been given to discuss genetic aspects of lysogeny.

In the first 50 pages are outlined all the information available in the literature on the origin and development of bacterial genetics and on the discovery of genetic recombination in bacteria. In the next 140 odd pages, the authors, who themselves are enthusiastic investigators in the field, have presented "a detailed analysis of the process of sexual conjugation in bacteria" and have discussed the mechanism of genetic transfer and genetic recombination. The remainder of the book is devoted to a discussion of "bacterial conjugation as a genetic system" with special reference to genetic material, genetic recombination and functional analysis.

The book is well written and well organised and provides all the essential information and yet is not overloaded. A special feature therein is the section in which important "conclusions" are succinctly presented. The volume should serve the purpose intended and will prove very useful to students and researchers of biology in general and microbiology in particular.

J. V. B.

**Advances in Pest Control Research, Vol. I.** Edited by R. L. Metcalf. (Interscience Publishers, Inc., New York), 1961. Pp. vi + 347. Price \$ 12.50.

This book is a symposium of eight papers purporting to give a survey of what has been

accomplished in the field of Pest control through microbial and chemical means.

In the introduction the Editor explains in a simple and precise manner the vast magnitude of damage caused by pests to man and his possessions and the importance of pest control. A perusal of the contents shows that a better arrangement could have been followed keeping in view the continuity and the relationship amongst the topics dealt with.

There is no doubt that the book is valuable with contributions from experts in the particular fields. The chapters are well presented with conclusive information, arresting the attention of the readers. Each topic has a synopsis in the beginning and an exhaustive list of references at the end.

In the first topic "Some fundamental aspects of applied insect pathology", definitions of the terms given concerning Epizootiology will make the subject understandable even to beginners in the field. The methods of microbial control have been dealt with in a lucid and interesting manner. It would have been better if more details regarding concentrations and dosages for field-scale trial had been given.

The second topic "Synthetic pyrethroids" deals more with the chemistry of the Pyrethrins than with their direct application to pest control.

The last topic "Digest of information on Malathion", is exhaustive, useful and interesting. It would be welcome if such detailed comprehensive digests on other important insecticides like Parathion, Endrin, etc., is forthcoming.

The book is clearly meant for teachers and research workers. Though by no means complete it stimulates the enquiring spirit of the reader.

The book has an excellent get-up with creamlaid paper and a good print.

M. PUTTARUDRIAH.

### Books Received

From: Academic Press, New York and London; India: Asia Publishing House, Bombay-1:  
*Advances in Electronics and Electron Physics.* (Vol. 15). Edited by L. Marton, 1961. Pp. x + 412. Price \$ 13.00.

*Advances in Applied Microbiology* (Vol. 3). Edited by W. W. Umbreit, 1961. Pp. xi + 421. Price \$ 13.00.

*Quantum Theory.* Edited by D. R. Bates, (Vol. II)—Aggregates of Particles. Pp. xi + 475. Price \$ 11.00; (Vol. III)—Radiation and High Energy Physics. Pp. xiii + 402. Price \$ 10.00.

- Advances in Immunology* (Vol. I). Edited by W. H. Taliaferro and J. H. Humphrey, 1961. Pp. x + 423. Price \$12.00.
- Immunodiffusion*. By Alfred J. Crowle, 1961. Pp. x + 333. Price \$10.00.
- Advances in Computers* (Vol. 2). Edited by Franz L. Alt, 1961. Pp. xiii + 434. Price \$14.00.
- From: Addison-Wesley Pub. Co., Reading, Massachusetts, U.S.A.:
- Molecular Biophysics*. By R. B. Setlow and E. C. Pollard, 1962. Pp. xiii + 545. Price \$11.75.
- Group Theory and Its Application to Physical Problems*. By Morton Hamermesh, 1962. Pp. xv + 509. Price \$15.00.
- An Introduction to Physical Oceanography*. By W. S. Von Arx, 1962. Pp. x + 422. Price \$15.00.
- From: The British Council, Reviews Department, 59 New Oxford Street, London, W.C. 1; Butterworth & Co., 4 & 5 Bell Yard, London, W.C. 2:
- Experimental Cryophysics*. Edited by F. E. Hoare, L. C. Jackson and N. Kurti, 1961. Pp. xv + 388. Price 75 sh.
- Ultraviolet and Visible Spectroscopy*. By C. N. R. Rao, 1961. Pp. xiii + 164. Price 30 sh.
- Molecular Energy Transfer in Gases*. By T. L. Cottrell and J. C. McCoubrey, 1961. Pp. vii + 205.
- Valency and Molecular Structure* (2nd Edn.). By E. Cartmell and G. W. A. Fowles, 1961. Pp. xii + 294. Price 32 sh.
- From: Cambridge University Press, Bentley House, London, N.W. 1:
- Resonance Radiation and Excited Atoms*. By A. C. G. Mitchell and M. W. Zemansky, 1961. Pp. xvi + 338. Price 18 sh. 6 d.
- Elements of the Topology of Plane of Points*. By M. H. A. Newman, 1961. Pp. xi + 214. Price 18 sh. 6 d.
- Atomic Theory and the Description of Nature*. By Niels Bohr, 1961. Pp. 119. Price 8 sh. 6 d.
- From: Pergamon Press, Ltd., Headington Hill, Hall, Oxford:
- Electromagnetic Wave Guides and Cavities*. By Georg Goubau, 1961. Pp. xvii + 656. Price £ 5-00.
- A Course of Advanced Mathematics for Technical Schools*. By N. P. Tarason, Translation Editor: B. G. Walker, 1961. Pp. 456. Price 42 sh.
- Vocabulary of Mechanics—Collective Work* 1962. Pp. vii + 190. Price £ 5-00.

## SCIENCE NOTES AND NEWS

### Award of Research Degree

The Maharaja Sayajirao University of Baroda has awarded the Ph.D. degree in Chemistry to Shri G. H. Patel, for his thesis entitled "Studies in the Synthesis of Dihydroxyquinolines, Diquinolyl Methanes (with u.v. absorption spectra) and Halogenation of Hydroxyquinolines".

### Institution of Chemists (India) Associateship Examination, 1963

The Thirteenth Associateship Examination of the Institution of Chemists (India) will be held in November, 1963. The last date for Registration is 30th November, 1962. The Examination in Group A (Analytical Chemistry) is divided into the following eleven sections and each candidate will be examined in two of them according to his choice as approved by the Council, in addition to the General—Chemistry including Organic, Inorganic, Physical and Applied—Analytical Chemistry: (1) Analysis of Minerals, Silicates, Ores and Alloys; (2) Analysis of Drugs, Pharmaceuticals; (3) Analysis of Foods; (4) Analysis of Water and Sewage;

(5) Biochemical Analysis; (6) Analysis of Oils, Fats and Soaps; (7) Fuel and Gas Analysis; (8) Analysis of Soils and Fertilisers; (9) Analysis connected with Forensic Chemistry; (10) Analysis connected with Leather Chemistry, and (11) Analysis connected with Textile Chemistry. The Examination is recognised by the Government of India as equivalent to M.Sc. in Chemistry for purposes of recruitment of Chemists.

Further enquiries may be made to the Honorary Secretaries, Institution of Chemists (India), Chemical Department, Medical College, Calcutta-12.

### Fifth Technical Convention of the Institution of Telecommunication Engineers (India)

The Institution of Telecommunication Engineers organised a Technical Convention on 13th and 14th January 1962.

Thirty-five papers were presented and discussed in the four half-day sessions into which the convention divided. The first session contained papers on ionospheric propagation, Radio Noise, Components including Solid State

Devices—their standards, specifications and tropicalisation. Mr. A. C. Ramchandani, Chief Engineer, All-India Radio, New Delhi, presided over the session. The Research Department of All-India Radio presented a series of papers on ionospheric investigations including analysis of some of the I.G.Y. data collected by them.

The second session was devoted to Microwave Circuits and Components. The Chairman of the session was Dr. Amarjit Singh, Deputy Director of Central Electronics Engineering Research Institute, Pilani.

In the third session presided over by Mr. C. P. Vasudevan, Director, Telecommunication Research Centre, Posts & Telegraphs Department, papers on Industrial Electronics, Systems Engineering, Computer Techniques, Television, etc., were read.

In the fourth and the last session papers on Transistor Technology, and Sound Engineering were presented. The Chairman for the session was Dr. N. B. Bhatt, Deputy Chief Scientific Officer, Defence Science Laboratory, Delhi.

The Technical Convention was attended by research workers from universities and research organisations all over the country. The Institution is considering publication of these papers in its Journal. The papers will be grouped and special issues will be brought out on specific subjects.

#### All-India Congress of Zoology, 1962

The Second All-India Congress of Zoology will be held at Varanasi from October 15 to 21, 1962, under the auspices of the Banaras Hindu University. The Congress has been sponsored by the Zoological Society of India with the assistance of an Advisory Board consisting of leading Indian zoologists. All papers intended to be presented before the Congress must reach the Office of the General Secretaries by June 30, 1962.

Further particulars can be had from the General Secretary, c/o Post-Graduate Department of Zoology, Utkal University, Ravenshaw College, Cuttack-3.

#### New Concept of the Van Allen Belt

A revised picture of the Van Allen Belt is emerging out of the data transmitted back to earth from satellites launched last year. Instead of two distinct belts of charged particles that have been envisaged up to now, there appears to be just one deep dough-nut-shaped radiation band around the earth containing an assortment of electrons and protons with energies ranging from 50,000 electron volts up to several 100 Mev., all caught in the earth's magnetic field.

The concept of two Van Allen Belts arose from the fact that the first satellites to penetrate the region carried only high energy particle detectors. The presence of particles of lower energy was discovered only when later satellites sent up to explore these regions were equipped with suitable detectors for this purpose. New results have shown that 50,000 volt electrons as well as protons with energy of several hundred thousand electron volts are found in both the inner and outer regions.

These results lead to a new conception of the earth as being surrounded by a "magnetosphere", a single radiation zone beginning 400 miles above the equator and extending out to 40,000 miles. Protons with energies up to several 100 Mev. are found out to 4,000 miles, and electrons with energies of several Mev. beyond that. Low-energy electrons and protons are encountered throughout the entire magnetosphere, by exploring vehicles, at rates  $10^7$  to  $10^9$  per sq. cm. of exposed surface per second. The outer boundary of the magnetosphere is not fixed but moves back and forth in response to the interplay of the solar wind—cloud of charged particles from the sun—and the earth's magnetic field which traps the particles to form the radiation belt. A region of great turbulence therefore marks the transition from the magnetosphere to interplanetary space.—(*Sci. American*, 1962, 206, 68).

#### Phase Transformation in BeO.

T. W. Baker and P. J. Baldock, of the Metallurgy Division of the Atomic Energy Research Establishment, Harwell, report a case of high-temperature phase transformation observed in beryllia. Investigations using a high-temperature X-ray diffractometer have shown that there occurs a reversible phase transition in beryllia at about 2050° C. Interplanar spacings were recorded over the angular range 35°–140° ( $2\theta$ ), using copper  $K\alpha$ . The new phase appears at  $2080 \pm 50^\circ$  C. on heating, which reverts to the usual hexagonal beryllia structure at  $1980 \pm 50^\circ$  C. on cooling. In each case the phase-change takes place over some 30° C. The high-temperature phase seems to have pronounced cubic characteristics.—(*Nature*, 1962, 193, 1172).

#### Triple Awning in Rice

Shri R. Seetharaman, Central Rice Research Institute, Cuttack-4, describes a variation in awning in rice hitherto unreported. In the  $F_3$  generation of a cross between two *glaberrima* types a plant was noticed in which one of the spikelets had three awns. The awns on exami-

nation were found to have developed as extension of three nerves of the lemma. Subsequent breeding behaviour showed that this variation is only teratological in nature. It, however, suggests that the nerves of the lemma and palea are individually capable of developing into awns but under normal conditions only the middle nerve of the lemma and occasionally the middle nerve of the palea get prolonged into awn with a general suppression of this tendency in the remaining nerves.

Incidentally, it may be mentioned that in barley which is another naturally self-pollinated crop a mutant with triple awned lemma has been described. (A teratological occurrence of double awned spikelets in rice has been recorded—see *Curr. Sci.*, 1936, 4, 739.)

#### New Phenomenon in Magnetoresistance of Bismuth

The study of the galvanomagnetic properties of pure bismuth at low temperatures, ca.  $2^\circ\text{K}$ ., and at magnetic fields above several kilooersteds, has revealed an interesting new phenomenon according to L. Esaki (*Phys. Rev. Letters*: 1962, January 1). The experiment essentially consisted in plotting the current-voltage curves in specimens of pure bismuth kept at specified low temperatures and magnetic fields.

Several specimens of cross-section  $1\text{ mm.}^2$  and length 0.5 to 5 mm. were carefully cut from pure bismuth single crystals grown by a special technique. The direction of flow of current was chosen parallel to the bisector direction between the binary and the bisectrix axes. The magnetic field was perpendicular to the direction of the applied electric field.

It was observed that the slope of the linear current-voltage curve which was small at first suddenly changed to a steep value at a certain high electric field which we may call the kink field. The kink field was magnetic-field-dependent, and it was observed that after the onset of the kink there was a considerable drop in the magnetoresistance, as much as one-fiftieth from the normal. There is a simple linear relation between the magnetic field  $B$ , and the kink electric field  $E_k$ , given by  $E_k = \alpha B$ , where the constant  $\alpha = 10^3$  volt/cm. oersted, over the whole range of the applied magnetic field.

As an explanation of the phenomenon the following may be considered: The motion of a charged particle in crossed magnetic ( $B_z$ ) and electric ( $E_y$ ) fields is classically given by a cyclotron rotation ( $\omega, r$ ) which is dependent on the mass and velocity of the particle, and a

motion of velocity  $v = cE_y/B_z$ , in the  $x$  direction, which is independent of both the particle's mass and its velocity, as well as the sign of its charge.

In the present case the velocity  $v$  comes out to be approximately  $10^5$  cm./sec. at the kink electric field. This numerical value is comparable to the velocity of sound in bismuth. This fact may suggest that a strong electron-phonon interaction occurs when the velocity  $v$  reaches this critical value. The experimental fact that the sharpness of the kink and the differential resistance beyond the kink field vary with the crystal orientation may indicate the directional dependency of the strength of coupling between the electrons and the phonons.

There is evidence to indicate that the new phenomenon is related to the establishment of acoustic standing waves built up of frequencies that resonate corresponding to the size of the specimen, in other words, the generation of coherent phonons in the crystals.

#### New Calorelectric Effect

When an oxygen-coal gas flame is directed on to two electrodes kept at temperatures differing by several hundred degrees, a potential difference of several volts develops between the electrodes. By increasing the conductivity of the flame with alkali vapour and the area of contact between flame and electrodes, and by reducing the length of the current path in the flame, currents up to several amperes have been drawn from this or similar systems. S. Klein, who first investigated this effect, found that the E.M.F. depends apparently on the temperature difference between the electrodes and is essentially independent of the electrode materials and the composition of the flame gas used. However, the origin of the "calorelectric force" in such a heat-to-electricity converter remained obscure.

Cozens and von Engle of the Clarendon Laboratory, Oxford, who have theoretically investigated the phenomenon have proposed the following mechanism for the new effect observed: it is known that in flames the degree of ionization is in general far above that obtained from the Lindemann-Saha equation of thermal ionization. This is not surprising because the system is in a steady state, but not in thermodynamic equilibrium, energy being supplied by combustion and removed by thermal conduction and gas flow. As a result of the combustion reactions excited molecules are formed and electrons gain high energy by collisions of the *second kind*. If the flame gas

ensity were sufficiently low, the system would analogous to the positive column of a glow charge where the large random energy of electrons causes the walls to acquire a negative potential with respect to the axis. However, because of the high gas density in plasmas, the mean energy of the electrons is not uniform but decreases towards the wall because electrons lose more energy by collisions in denser regions near the wall.

Results of mathematical analysis of heat flow near a cool conducting wall show that as the wall temperature is reduced the electrons striking the wall suffer an increasing number of collisions and lose more energy. Thus the electrons will charge a cold wall to a smaller negative potential than a hot wall. The calorimetric effect is therefore a manifestation of the difference in wall potential between two walls at different temperature whereby the cold wall could be at a positive potential with respect to the hot wall. This, in fact, has always been observed.—(*Nature*, 1962, 193, 1170).

#### Lithium Radiation in Twilight Sky and Nuclear Test Explosions

Observations of lithium resonance lines in twilight sky have been reported from time to time. The very large intensities of the resonance line 6707.8 Å, observed in August and September 1958, have been, at least partly, ascribed to lithium artificially produced from high altitude thermonuclear explosion (*Curr. Sci.*, 1959, 28, 5). It will be of interest to know whether there was confirmation of this during the Soviet nuclear tests in September and October 1961.

In a note contributed to *Nature* (1962, 193, 64), H. M. Sullivan and D. M. Hunten report the results of their observations on the brightness of lithium twilight which they had conducted during 1961 at the Institute of Upper Atmospheric Physics, University of Saskatchewan. The instrument used was an improved type photometer with a red-sensitive photomultiplier, E.M.I. type 9558B, with a tri-alkali thode. The photometer, which was brought into operation in May 1961, was unable to detect any emission on most occasions until the beginning of October. Thus, for most of this period, the brightness was less than the threshold value of 10 Rayleighs (R.), corresponding to an emission of  $10 \times 10^6$  photons/cm<sup>2</sup>. Observations after the beginning of October showed that the brightness slowly increased from 12 to 30 R. with a sudden jump to 400 R., on November 1, then fluctuated about 200 R., and showed a second peak of about 400 R. on

November 10. The U.S.S.R. set off a series of nuclear explosions towards the end of October and early in November. Only the two largest in this series, the one of 40 megaton range on October 23, and other of 60 megaton range on October 30, appear to have injected lithium into the 80-km. region, if it is assumed that the material took about 10 days to reach Saskatoon. Alternatively, the first peak, observed on November 1, could be associated with the 60-megaton explosion with a time-delay of 2 or 3 days. The appearance of lithium depends on the height of the explosion as well as its size. Although the correlation with nuclear explosions is attractive, it still cannot be regarded as fully established. The possibility of a natural abundance peak during these months should also be explored. A calculation of Sodium/Lithium ratio showed that it fell from 8000 for October to about 800 in November, or even less at the beginning of the month.

#### Soviet Satellites to Explore the Upper Atmosphere

In accordance with the programme for exploring the upper strata of the atmosphere and the outer space the U.S.S.R. have launched a series of artificial satellites in March-April 1962. Cosmos-I was launched on March 16. The satellite was placed into orbit with a perigee of 217 km. and an apogee of 980 km. The orbital angle was 49°, and the period of revolution was 96.35 minutes.

Cosmos-II was launched on April 6. Its perigee was 211.6 km., and apogee 1545.6 km. The period of revolution was 102.25 minutes.

Cosmos-III was successfully orbited on April 24. Its period of revolution was 93.8 minutes, and orbital inclination 48° 59'. The perigee distance was 229 km. and the apogee 720 km.

Cosmos-IV was launched on April 26, on an almost circular orbit, close to the calculated one, with the following parameters: initial period 90.6 min., apogee 330 km., perigee 298 km., and inclination of the orbit to be equatorial plane 65°. After orbiting the earth for over 3 days during which time it covered a distance of some 2 million kilometres, it was successfully landed at a pre-determined point of the Soviet Union on April 29, on a signal from the earth. Research information obtained from Cosmos-IV is now being processed and studied.—(*U.S.S.R. News*).

#### Highly Ionized Fe-Lines in the Coronal Spectrum

Perhaps the best method of checking the ionization equilibrium of the solar corona is

provided by the spectroscopic study of the lines emitted by Fe atom at various stages of ionization. J. Firor and H. Zirin, of the High Altitude Observatory, Colorado, report the measurements of the intensity of coronal emission lines from Fe x, Fe xi, Fe xiii, Fe xiv and Fe xv. The six lines in the accessible part of the spectrum that have been studied are: Fe x 6374.51, Fe xi 7891.94, Fe xiii 10746.80 and 10797.95, Fe xiv 5302.86, and Fe xv 7059.12.

The detailed investigation of this group of lines with high dispersion and in rapid succession was made possible by the use of an infra-red image converter in conjunction with a Climax coronagraph. The observations show no tendency for iron to be concentrated in the Fe x and Fe xiv stages as has been suggested by earlier workers.

Fe xii has no lines because it has a half-filled shell ( $p^3$ ); consequently it has no spin-orbit splitting between which transitions may occur.—(*Astrophys. Jour.*, 1962, 122).

#### Anglo-U.S. Co-operation in Space Research —the S-51 Satellite

The "S-51" international ionosphere satellite, an Anglo-American experiment, is the first example of international co-operation in the use of earth satellites. The launcher, a "Delta" rocket, the telemetry and the satellite shell are American; the instrumentation is British.

The satellite was lifted off the launching pad by the three-stage Delta rocket at 18:00 hrs. GMT on April 26, from Cape Canaveral, in Florida, U.S.A. Within minutes of blast-off the vertical path of the rocket changed to a horizontal trajectory in a roughly south-easterly direction some 200 miles above the earth. Then, somewhere over the sea off South America, the satellite was injected into orbit at about 18,000 miles per hour.

About 20 minutes after launching, an operation was completed successfully to reduce the rate at which the satellite had been spinning and to deploy its solar paddles and scientific probes. This was observed to take place by radio signals received in HMS *Jaguar*, stationed off Tristan da Cunha, in the South Atlantic.

The satellite is now orbiting the earth as planned at heights of between 200 and 600 miles. It is designed to make some 5,000 circuits over a period of about a year.

The satellite is basically a cylinder 23 in. in diameter and 20 in. high, and weighs about

150 lb. Power for the instruments is derived from four paddles covered with solar cells.

The British-designed and -built instruments are intended for making, for the first time, measurements over a year in orbit on the electrical state of the high atmosphere and its dependence on the activity of the sun as observed and recorded by other instruments. Also, measurements will be made of fast cosmic particles coming in from outer space at the same time as they are being observed by high-flying Canberra aircraft based at Farnborough, Hampshire.

#### Ruby Maser as New Light Source for Raman Spectra

A radically new light source—the optical maser—with its intrinsically high intensity, extremely narrow line width and strong directionality is ideally suited to Raman spectroscopy. Already several types of optical masers have been successfully operated, including a gas maser (operating continuously at  $\lambda$  11,530 Å) and three solid state masers (pulse operated at  $\lambda$  6940,  $\lambda$  7080, and  $\lambda$  25,000 Å). Of these the ruby maser appears to be the most suitable as a Raman source at the present time. Its emission is at  $\lambda$  6940 Å, with energy output up to 1 joule (peak power about 10 kw.) and with a line width of less than  $0.01 \text{ cm}^{-1}$  for good ruby samples. The ruby maser has already been successfully used to excite the Raman Spectra of liquid  $\text{C}_6\text{H}_6$ ,  $\text{CCl}_4$ ,  $\text{CS}_2$ ,  $\text{SnCl}_4$ , and solid  $\text{CaF}_2$ . These spectra were photographed on IN plates with high speed spectrographs in effective exposure times of the order of 50 msec. Two Raman Cells were used with the liquids: one making use of total internal reflection; the other of diffuse reflection as in an integrating sphere, with illumination of the sample by the parallel beam of the maser through a small window, the scattered light being observed at right angles to the maser beam.

The future development of new optical masers operating at shorter wavelengths and of electronic detection techniques (making use of beat frequencies between the illuminating light and the scattered light) will open exciting new possibilities for the investigation of Raman spectra. [*Methods of Experimental Physics* (Vol. 3)—*Molecular Physics*, Edited by Dudley Williams, (Academic Press, New York & London), 1962, p. 154].

## PROBLEMS OF NUCLEAR RESEARCH

### Twelfth Session of the Joint Nuclear Research Institute, Dubna

THE 12th Session of the Learned Council of the Joint Institute of Nuclear Research was held at Dubna in the last week of May 1962. The session discussed the reports on problems of nuclear research carried out at the Joint Institute in the past six months. The work done at the High Energies Laboratory was reported by the two scientists Yevgenya Kladnitskaya and Eduard Tsyganov. Ascertaining the structure of the nucleons is one of the principal tasks of modern physics of high energies. One of the conclusions drawn as a result of research carried out so far is that nucleons in general are highly complex formations, in no way simpler than the atom. Kladnitskaya outlined the results of the work done in the laboratory with special reference to the production under laboratory conditions of neutral hyperons and K-mesons.

In his report on the analysis of elastic scattering of protons at energies of 2 Bev to 25 Bev, Tsyganov summed up the experimental data obtained by scientists in Dubna, Sofia, and Tashkent, and discussed them in the light of the results published by nuclear physicists of the Western countries.

Prof. Vaclav Petrilka of Czechoslovakia reported on the non-elastic collisions of negative high-energy pi-mesons with nucleons. The conclusions made in the report confirm the opinion of theoretical physicists that the nucleon consists of a more dense central region surrounded by a meson cloud; but the final solution of the problem can be solved only by more delicate and comprehensive experiments, and even more "complex theoretical calculations and generalisations".

A large number of papers read at the session dealt with researches conducted during this year on the experimental investigation of the problems of interaction between elementary particles. Yuri Prokoshkin and his co-workers described a new observation, namely, the decomposition of positive pi-meson into neutral pi-meson, positron and neutrino. Theoretically this process had already been visualised by nuclear scientists and the theory was based on the hypothesis of preservation of certain charge equal for all particles and characterising weak interaction. This process, in which particles existing for only some millionths part of a second take part, has an analogue in the sphere of ordinary beta-decomposition of neutron. The

difficult nature of the experiment can be illustrated by the fact that only a few of the six billion positive pi-mesons that passed through the installation yielded the necessary effect. This discovery indicates a way to the establishment of a general law governing the decomposition of elementary particles.

A paper submitted by a group under Prof. Brono Pontecorvo and R. Sulyayev dealt with the experimental investigation of the capture of mu-mesons by  $\text{He}^3$  nuclei. Such reaction had not been observed before and the determination of its probability is of greatest interest because it makes possible a most precise definition of the scale and size of weak interactions between elementary particles. In another paper Pavel Yermolov gave the results of an experimental investigation of a whole complex of the so-called mesonic atom processes.

On the last day of the session (May 25), reports were read on researches carried out in the current year at the laboratory of Theoretical Physics headed by Academician Nikolai Bogoluybov. One of these reports, by Gabor Domokos of Hungary, was devoted to the problem of interaction of elementary particles under high energies and the connection of differential scattering with unstable particles. The work of Domokos, together with the studies of the Soviet physicists Pomeranchuk and Gribov, the American scientist Hellman and others, opens up prospects for the cognition of the nature of interaction between elementary particles.

A big role is played in modern theory by the notion of gauge invariance, which is closely related to the preservation of the electric charge in electromagnetic fields. Lately, gauge invariance has been raised by a number of prominent scientists into a principle from which the existence of new particles of vector mesons is said to stem. This contention, however, was refuted in a paper presented at the session by V. Ogievetsky and I. Polubarinov.

Another paper presented at the concluding session concerned the processes of the interaction of pi-mesons with pi-mesons. Results of studies of this process under low energies on the basis of the so-called dispersion approach developed by Bogoluybov and his followers, were discussed and these results indicate that under low energies two pi-mesons should be attracted. —(By courtesy of the USSR Embassy in India.)

## LIFE-FORMS IN METEORITES

**E**VER since B. Nagy, W. G. Meinschein and D. J. Hennessy, published the findings of their mass spectrographic study indicating that carbonaceous substances in the Orgueil meteorite were produced by living organisms, interest in the study of carbonaceous meteorites has increased (*Ann. N.Y. Acad. Sci.*, 1961, 93, 25; also see *Curr. Sci.*, 1961, 30, 245). G. Claus and Nagy have again reported (*Nature*, 1961, 192, 594) on the presence of "organized elements", or life-like forms morphologically resembling unicellular microfossils, in the Orgueil and Ivuna meteorites. The implications of these observations are extremely far-reaching and at present there seem to exist serious difficulties on their interpretation. In this context the symposium of articles by recognized authorities (published in *Nature*, 1961, 193, 1119-33) will be read with great interest as they summarize the present position regarding the intriguing speculation about the possible extraterrestrial origin of life.

Prof. H. C. Urey, who contributes the first article, explores the possible origins of these life-forms observed in carbonaceous meteorites. From the environmental side, liquid water appears to be a necessary medium if life resembling that on Earth is to evolve. After discounting the Asteroids and Mars as the possible places of origin, Prof. Urey advances what he calls "the Moon-capture hypothesis". According to this hypothesis the Moon became contaminated temporarily with water and life-forms from Earth early in its history, when the capture of the Moon by the Earth took place, that these forms have been preserved there since that time and that they are now returning to Earth. This conclusion requires that the lunar surface consists of materials of compositions and physical structures similar to those of the stone meteorites. It also requires that processes capable of transferring water to the Moon existed at a remote time, and that processes capable of removing objects from the Moon exist at the present time.

Prof. F. Fitch, Dr. H. P. Schwarcz and Prof. E. Anders, of Chicago University, reporting on their study of Orgueil and Ivuna meteorite samples from the Paris and Chicago Natural History Museums, bring evidence to show the inorganic nature of the particles observed, and

say that they are not the organisms themselves but their fossil forms converted to troilite or sulphur. While they agree to the possible extraterrestrial origin of these organized elements "to regard these organized elements as possible remnants of organisms is another matter".

M. H. Briggs and G. B. Kitto, of Victoria University Wellington, New Zealand, from their study of the Mokoia meteorite, which is a carbonaceous chondrite, conclude that "the meteorite contains complex organic micro-structures of extraterrestrial origin, a minority of which resemble unicellular organisms, but most are present as unorganized fragments. The evidence is compatible with either a biogenic or an abiogenic origin for the micro-structures."

Nagy, Claus and Hennessy in the concluding article of the symposium present further observations on the organic particles embedded in minerals in the Orgueil and Ivuna carbonaceous chondrites, and state, that "the experiments seem to indicate that these microscopic particles are fossilized, organic, organized structures which are not likely to be minerals, organic artefacts or terrestrial, microbiological contamination".

In summing up and commenting on the problem J. D. Bernal stresses the remarkable difficulties of interpreting the evidence: "It seems to me we are forced to one of two conclusions. Either 'life' is a complex of phenomena which only follow for intrinsic necessity a very narrow range of chemical reactions, or there is only one sequence of evolution of life and the forms observed on the meteorites and here are genetically related. The first alternative seems inherently improbable, but the second strains the imagination as to how these transfers may have been effected." It is possible, he thinks in accordance with a suggestion made by J. B. S. Haldane, that "life is much older than the Earth and was brought from some part of the Galaxy or indeed from other galaxies."

While on this subject we invite our readers' attention to the recent publication\* *Researches on Meteorites* by C. B. Moore which is of topical interest. The book is based on a symposium on meteorites held at Arizona State University, in March 1961. The contributors being well-known scientists from different parts of the world who are actively engaged in meteorite research problems, the book is up-to-date and authoritative. The information provided is indispensable to those engaged in this new and exciting field of research.

\* *Researches on Meteorites*. Edited by C. B. Moore (John Wiley and Sons, Inc., 440, Park Avenue South, New York-16, N.Y.), 1962, pp. xii+227, Price \$ 7.00.



## THE CHROMOSOMAL PELLICLE

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### INTRODUCTION

THE problem whether the chromosomes have a distinct limiting membrane has elicited differing opinions.<sup>1,2</sup> Micrurgical studies on the salivary chromosomes of *Chironomus*<sup>3</sup> indicated the presence of an elastic membrane which when ruptured made the chromosomes sticky. In some flagellates of termites the new nuclear membrane was found to originate by the fusion of the membranes of the chromatids.<sup>4</sup>

Evidence from electron microscopy regarding the structure of the chromosomes is rather confusing.<sup>2,5,6</sup> The disagreements range from an inability to confirm "the presence of any highly organized structures"<sup>5</sup> (p. 143) in the chromosome to its resolution into a large number of paired fibrils suggestive of a polynemic structure.<sup>2</sup> Electron micrographs showing a wealth of detail do not seem to have rendered possible a distinction of the sheath, the matrix and the chromonemata as separable entities, though such a distinction was said to be possible in favourable living material<sup>4</sup> (p. 12). In sea urchin eggs, the limiting membranes of anaphase chromosomes have been considered to be an assemblage of material for the future nuclear membrane, since they resemble the nuclear membrane in their structure<sup>6</sup> (pp. 309-310, Fig. 75).

Our knowledge of the patterns of association of the nucleic acids and proteins in chromosomes has been collated mostly from staining acetic-alcohol fixed onion roots treated with enzymes and acids<sup>2</sup> (pp. 110-111). The structural details of the chromosomes could be revealed by very simple procedures.<sup>7,8</sup> A distinct membrane delimiting the metaphase chromosomes was observed during an evaluation of the suitability of acetic-alcohol for a study of chromosome structure. Perhaps, the discovery of the chromosomal membrane itself was due to the superiority of the hæmatoxylin squash technique<sup>7,9-11</sup> in its crisp delineation of the chromosomal details.

### OBSERVATIONS

Root-tips from bulbs of *Allium cepa* germinated in an incubator at 30° C. were fixed in acetic-alcohol (1:3) for 24 and 96 hr. at a

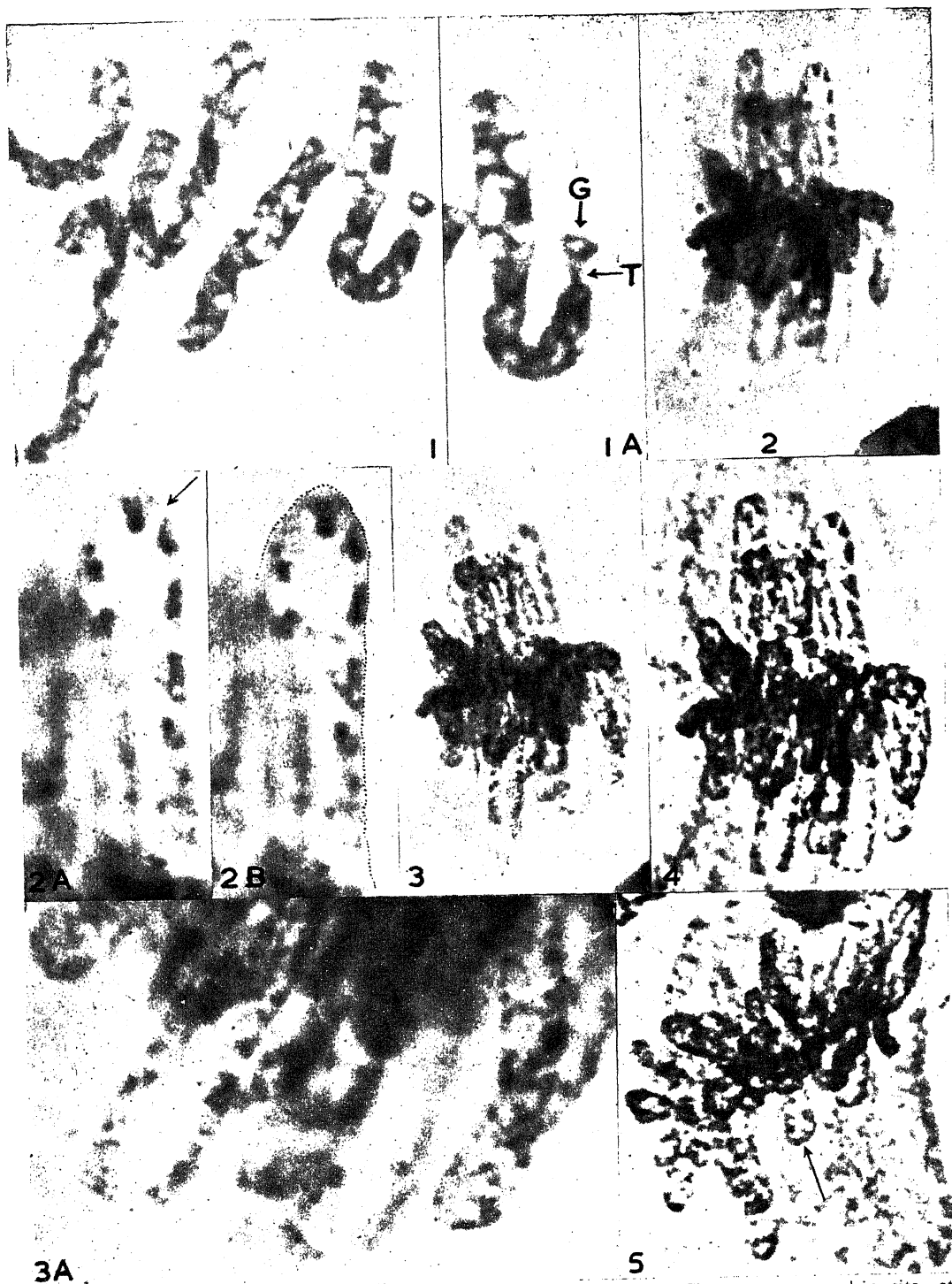
room temperature of 26-30° C. Interspaced with washes in repeated changes of distilled water of 10-15 min. duration, the fixed material was hydrolysed in NHCl at 60° C. for 10 min., mordanted in 4% ferric ammonium sulphate for 10 min., stained in a 0.5% solution of hæmatoxylin (B.D.H.) for 5 min., teased into small bits and squashed in a drop of 45% acetic acid. The edges of the coverslip were sealed with paraffin wax.

In material fixed for 24 hr. the structure of the meta- (Photos 1 and 1A) and anaphase chromosomes were exactly similar to those illustrated earlier from other techniques.<sup>7,8</sup> Attention is invited to the diverging SAT-threads and the vesiculate SAT-grain in Photo 1A. Three types of chromosome configurations were observed in roots exposed to the fixative for 96 hr. Very few metaphases showed the quadri-partite structure illustrated in Photos 1 and 1A. There is a gradual digestion and consequent disorganization of the chromonemata on long storage of the roots in the fixative resulting in the chromosomes appearing either as structureless ribbons, or as closed hollow tubes composed of pellicles, with stainable granular matter disposed along their inner borders.

This is illustrated in Photos 2, 2A, 3 and 3A of the same cell taken under ordinary illumination. Only one chromosome is in focus in Photo 2 and an enlarged picture of it is presented as Photo 2A. The chromosomal membrane is clear and distinct in the region indicated by an arrow and the granular remnants of the chromonemata are disposed along the inner border of this membrane. To emphasize the distinctness of this sheath and for comparison its contour is stippled with Indian ink in Photo 2B.

The ends of the chromosomes directed towards the bottom in Photo 2 are in focus in Micrographs 3 and 3A. The various stages of disappearance of the stainable matter within the pellicle are seen in the enlargement (Photo 3A) of the chromosomal arms. Further confirmation of the presence of a chromosomal membrane is offered by Phase Micrograph 4 of the same cell, where the majority of the chromosomal arms are in focus. The pellicle is clear in the chromosome indicated by an arrow

\* Scientists' Pool, C.S.I.R.



PHOTOS 1-5. Photo 1. Acetic-alcohol (24 hr.)-haematoxylin. Chromosomes quadripantite at metaphase. Ordinary illumination,  $\times$  ca. 3,350. Photo 1 A. SAT-chromosome with diverging SAT-threads (T) and SAT-grain (G),  $\times$  ca. 3,950. Photos 2-4. Acetic-alcohol (96 hr.)-haematoxylin. A cell in metaphase under ordinary (Photos 1-3 A) and phase contrast (Photo 4), types of illumination showing the chromosomal pellicles. Photos 2 and 3,  $\times$  ca. 1,200. Photos 2A, 2 B and 3 A,  $\times$  ca. 3,500. Photo 4,  $\times$  ca. 1,360. Photo 2 B. The chromosomal pellicle is stippled with Indian ink. Photo 5. Metaphase. The arrow indicates the pellicle of a chromosome,  $\times$  ca. 1,360.

in another metaphase illustrated in Phase Micrograph 5. At anaphase the outlines of the chromosomes alone are visible under phase

branes may be transformed into the nuclear membrane.<sup>4</sup> In squashes where the caduceus coilings of the chromonemata are seen (Photos 1



PHOTOS 6-7 B. Photo 6. Anaphase. The chromosomes appear as hollow tubes,  $\times$  ca. 1,360. Photo 6A. Part of Photo 6 enlarged. Arrow indicates the pellicle,  $\times$  ca. 9,350. Photos 7, 7 A and 7 B. Acetic-alcohol-formaldehyde (3 hr.)-haematoxylin. The nuclear membrane could be seen bounding the protruding chromosome arm. Photo 7,  $\times$  ca. 1,100. Photo 7 A,  $\times$  ca. 3,500. Photo 7 B,  $\times$  ca. 7,100.

contrast (Photo 6). The arrow indicates the pellicle of a chromosome (Photo 6 A) lying at the extreme left in the top group.

The presence of a sheath for meta- and anaphase chromosomes suggested that these mem-

& 1 A) a loosening of these coils was observed in one or two of the chromosomes which projected out of the packed telophase mass. These were bounded by a limiting membrane. The staining of this membrane could be accentuated by the

addition of 1 ml. of 40% formaldehyde to every 4 ml. of acetic-alcohol (1:3, cf.<sup>14</sup>). Therefore, roots fixed in the above mixture for 3 hr. were stained with hæmatoxylin, squashed and made permanent. Photos 7, 7A and 7B are of the same cell at different magnifications. The finger-like projecting arm of the chromosome is bounded by a membrane resembling that of the metaphase chromosomes.

#### DISCUSSION

The free ends of the chromonemata were seen but rarely<sup>7,8</sup> in preparations giving a crisp delineation of the structural details (Photos 1 & 1A). In an end view, the paired chromonemal threads had the appearance of rings (cf.<sup>2</sup>, p. 85). Our curiosity was roused by the possibility that such a configuration may be due to the alignment of the free ends of the chromonemata along the contour of a chromosomal pellicle. Contrary to the general belief,<sup>2,6</sup> the chromosomes of *Allium cepa* do have a distinct limiting membrane as illustrated in the micrographs.

The structural integrity of the chromosomes has been assigned variously to (a) DNA,<sup>12</sup> (b) a combination of DNA with residual protein<sup>13</sup> and (c) to a complex of RNA, DNA, histone and non-histone proteins.<sup>2</sup> It has been stated: "No one component can be singled out as the essential structural material. As the metabolic properties change from phase to phase and from cell type to cell type, structural patterns also change. In this flux and flow, first one chromosomal material and then another may be displaced or accumulated"<sup>2</sup> (p. 116).

The photographs presented would show that chromosomes not enclosed within a nuclear membrane retain their configuration even when their contents are digested and disorganized.

It would appear that it is the chromosomal membrane which gives the mitotic chromosomes their morphological integrity.

#### SUMMARY

Hæmatoxylin squashes of root tips of *Allium cepa* fixed for 96 hr. in acetic-alcohol (1:3) exhibited three types of chromosome configurations. Very few cells in metaphase showed the quadri-partite structure seen in material fixed for 24 hr. There is a gradual digestion of the chromonemata on long exposure to the fixative resulting in the chromosomes appearing either as structureless ribbons or as closed hollow tubes of chromosome pellicles. It would appear that it is the chromosomal membrane which gives the mitotic chromosomes their morphological integrity.

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#### A NEW FUNDAMENTAL PARTICLE—ANTI XI-PLUS $\Xi^-$

THE observation of a predicted hyperon, the anti Xi-plus ( $\Xi^-$ ) particle, produced in the collision of an antiproton with a proton has been reported simultaneously from two centres of high energy nuclear research.

The one is from the Brookhaven National Laboratory, Upton, New York, where the reaction  $\bar{p} + p \rightarrow \Xi^- + \Xi^+$  has been observed in a 20-inch liquid hydrogen bubble chamber exposed to a separated antiproton beam of 3.3 Bev/c. momentum produced in a tungsten target in the Brookhaven alternating gradient synchrotron. The particular event was found after 34,000 pictures had been scanned for strange particle

production. Each picture contained an average of 14 antiproton tracks.

The second report is from CERN, Geneva, Switzerland, where the interactions of fast antiprotons 3.3 Bev/c. with protons have been studied with the CERN proton synchrotron, and observed in the Scalay 81-cm. hydrogen bubble chamber. The event was observed in the course of the methodical scanning of the first 10,000 photographs with an average of 7 antiproton tracks per photograph.

While expected to exist the anti Xi-plus particle has so far not been observed, and these are the first observations reported.—(*Phys. Rev. Letters*, March 16, 1962.)

## LATERITES OF NELLORE, ANDHRA PRADESH

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**A**N area of about 400 sq. miles between Tada (66 C/2; 13° 35': 80° 2') in the south and Singarayakonda (66 A/4; 15° 13' 45": 80° 1' 45") in the north was mapped with particular reference to the nature of laterites and their extent in relation to the underlying rocks. Mapping has been facilitated by the numerous fresh sections of laterite and the underlying rocks exposed in the railway cuttings along the new double line on the Madras-Calcutta route.

Laterites in the Nellore area are of two types.

(i) Fresh, *in situ* laterite quarried as building stone is porous, pitted and clay-like, usually yellowish-brown in colour with slight pinkish tinge. The same rock when exposed for a long time acquires a hard protective crust of limonite and becomes dark. The rock shows elongated cavities. It is often pisolitic and cemented by ferruginous material. This does not contain pebbles. The thickness of the laterite varies from 3 to 30 feet. Usually adjoining the above and sometimes overlying it are laterites which are just cemented, hard, ferruginous pebble gravels. Their maximum thickness is about 6 feet. The pebbles are usually subrounded or oval and range in diameter from 5 to 25 mm. The matrix is ferruginous.

(ii) The second type is undoubtedly very recent in age and is made up of pebble gravels, shining reddish-brown in colour and occasionally mixed with small pieces of vein quartz and yellowish-brown sand. Microsections of the ferruginous gravels do not show any concretionary texture. In the area under investigation these occupy a large portion to the west of the main massive laterites. Where sections of the loose lateritic gravels are exposed they overlie granite gneisses, the two sometimes being separated by gravels of kankar, which is locally used for the manufacture of lime. It is of interest to note that palaeolithic implements made out of vein quartz are found among these gravels in many places. This horizon also contains numerous subrounded to rounded cobbles and these and the enclosing materials look like channel fillings. The thickness of this horizon is usually around 3 feet.

King<sup>1</sup> was the first geologist to map the sedimentary formations of Nellore area between N. Lat. 13° 30' and 15° 0'. Bruce Foote<sup>2</sup> mapped the same formations further north up to Krishna River. A comparison of the two maps shows

some anomalies at the junction between the two areas, which was pointed out even by King (p. 67). Bruce Foote included in his *Lateritic Formations* both the types of laterites mentioned above, whereas King's *Cuddalore Sandstones* (p. 67) includes the first type of laterite, since according to him it is the Cuddalore sandstone that has been ultimately altered to the massive laterite. The second type was described by him under 'Lateritic Deposits' (p. 71).

During the recent survey it was noted that the laterite is invariably underlain by granite gneisses, hornblende gneisses, quartzites and quartz schists, or garnetiferous gneisses. No section was seen in which the laterite is underlain by sandstone. Within the laterites near about the transition from the underlying gneisses, ramifications of veins of pegmatites, with the felspar (altered) and quartz are seen in many sections, as for example in a railway cutting one mile south of Bitragunta (57 N/14; 14° 46': 79° 59"). It is seen that some of the gneisses look like feldspathic sandstones, but in sections exposing more than 30 feet of these rocks, as in a place 2½ miles north of Tetu (66 A/4; 15° 2' 50": 80° 0' 15"), the change from the gneisses to the laterite through the weathered gneisses, looking like feldspathic sandstone, is clearly seen. In a few places like Rosanur (57 O/13; 13° 50' 20": 79° 54' 15") and Damavaram (57 N/14; 14° 42' 5": 79° 57' 50") the longer diameter of the cavities in the laterites are parallel to the foliation direction of the underlying gneisses pointing to their derivation from the gneisses. In the lateritic quarries about a mile south of Nellore (57 N/15; 14° 27': 79° 59') stray pieces of rock resembling gritty sandstones are sometimes met with but no clear sections showing them in place are seen. On the other hand, quartzites and gneisses along with quartz veins are seen jutting out of the laterites in the above quarries. In all likelihood the gritty nature of a few of the laterites could be due to the extensive occurrence of massive vein quartz and quartzites immediately west of the lateritic patches; the detrital quartz might have been derived from those rocks and embedded in the laterite.

In the Rajahmundry area the gradual change from the Rajahmundry sandstone (stratigraphically equivalent to Cuddalore sandstone) to the laterite is clearly seen in many sections.<sup>3</sup>

Laterites are seen capping Cuddalore sandstones east of Neyveli in Madras State, and similar material is found at Tanjore and to its south, continuing into Pudukotta. It is undoubtedly due to the lateritisation of the Tertiary sandstone. But from the available evidences in the Nellore area it is inferred that the laterites here are derived from the underlying gneisses and not from any sandstones. King (p. 68), however, does mention a few occurrences of laterites over gneisses in this area. The presence of laterite over almost every type of rock is known from different parts of India and hence it is not unlikely that the laterites of Nellore area are the altered product of the gneisses. Fox's<sup>4</sup> description of laterites of Malabar and Kanara which are derived from gneisses and granites is applicable to those of Nellore area also as both are of the same type and have been derived from gneissic rocks.

It is therefore concluded that the so-called 'Cuddalore sandstones' of King in the Nellore area are only laterites derived from the gneisses and are the same as the *Lateritic Formations* of Bruce Foote. It is possible that the Nellore area was not submerged during the Tertiary era and therefore does not possess any sandstones similar to those at Cuddalore, Neyveli, Tanjore and other places.

I am grateful to Dr. M. S. Krishnan who kindly reviewed the manuscript. The financial assistance of C.S.I.R. is thankfully acknowledged.

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### COLOUR OF AMAZONITE

**P**OTASH feldspar used in ceramic industry has a colour commonly varying between different shades of red, though grey and white varieties are also known. Sparsely, there occurs a green or blue-green variety, the amazonite, which has acquired a certain currency as a semiprecious stone because of its beautiful green colour. Pure potash feldspar that is heated until it melts forms a white mass, independently of the original colour.

Explanations of the cause of colours of feldspars are usually based on plausible assumptions. Thus the reddish colour of potash feldspar is attributed to the trioxide of iron,  $\text{Fe}_2\text{O}_3$ , which is present as an impurity. At the smelting of the feldspar  $\text{Fe}_2\text{O}_3$  is partly reduced to the divalent oxide  $\text{FeO}$  which dissolves in the feldspar glass causing a green colour. The feldspar melt then changes to white. This theory of the sequence of events is quite well-founded for many types of feldspar, and the described process explains why a whiter feldspar porcelain is obtained if suitably chosen reducing conditions are a part of the firing process.

In analogy with the above theory it has been assumed that divalent iron oxide  $\text{FeO}$  should be the cause of the amazonite's green colour. The green colour is also sometimes attributed to the presence of small quantities of copper or chromium oxide.

F. Sandford and J. A. Hedvall of the Chalmers University of Technology, as a result of some

systematic investigations, have proposed a new explanation for the green colour of amazonite, namely, that it is due to disturbances in the lattice structure. Sandford and Hedvall carried out the following experiments on amazonite from a Swedish deposit, Skantrop in the Isle of Orust: (i) Heating in the temperature range 20-1200° C. in atmospheres of air, nitrogen and hydrogen, (ii) Spectroscopic examination for establishing possible presence of copper and chrome oxide, (iii) determination of loss of weight on ignition, (iv) differential thermal analysis, and (v) X-ray investigation of the colour varieties obtained at different temperatures.

As a result of the above tests, the authors find that the traditional explanation of the various colour varieties of potash feldspar, i.e., they should be caused by colouring oxides of iron, copper, or chromium, cannot be correct in the case of the amazonite examined. On the other hand, there are excellent reasons, they contend, for assuming disturbances in the lattice may constitute a contributory cause. It is known that feldspars generally contain small quantities of chemically linked water the presence of which in the lattice may give rise to colour-changing effects. According to this explanation the pink colour of the naturally occurring feldspars would indicate that they have been formed under conditions that have permitted its lattice to attain a high degree of perfection.—(Trans. Chalmers University of Technology, Sweden, 1962, No. 257.)

## LETTERS TO THE EDITOR

CHLORINE PURE QUADRUPOLE  
RESONANCE IN SOLIDS

Using the conventional frequency modulated super-regenerative oscillator, chlorine pure quadrupole resonance has been observed in (1) 4-chloro-1, 3-dinitro-benzene, (2) 3, 4-dichloro-nitro-benzene, (3) 2, 5-dichloro-nitro-benzene and (4) 2, 3-dichloro-nitro-benzene. The frequencies have been measured by superimposing the first harmonic of the signal from a BC-221 Q frequency meter (range 125 Kc./s. to 20 Mc./s.) on the central component of the resonance line. The frequency accuracy may be estimated as less than  $\pm 10$  Kc./s.

In compounds (2) and (3) two lines have been observed for  $\text{Cl}^{35}$  and in (1) and (3) resonance lines due to  $\text{Cl}^{37}$  are also observed. All the lines are observed and measured at room temperature ( $28^\circ\text{C}$ ). A single crystal of 2, 5-dichloro-nitro-benzene has been grown in benzene and two lines of  $\text{Cl}^{35}$  and two of  $\text{Cl}^{37}$  have been observed in this crystal.

The frequencies of the lines together with the literature values of the compounds reported at  $77^\circ\text{K}$ . are given in Table I. The ratio of  $\nu(\text{Cl}^{35})/\nu(\text{Cl}^{37})$  is in agreement with the literature values determined from NQR frequencies in several other chlorine compounds.<sup>1-3</sup>

TABLE I

Compound	Resonance frequency ( $\nu$ ) in Mc./s.		$\nu\text{Cl}^{35}/\nu\text{Cl}^{37}$	Literature value $\nu(\text{Cl}^{35})$
	$\text{Cl}^{35}$	$\text{Cl}^{37}$		
4-chloro-1, 3 dinitro-benzene	37.28	29.38	1.26889	37.796 <sup>4</sup>
3, 4-dichloro nitro-benzene	35.99	..	..	36.488 } <sup>5</sup>
	36.38	..	..	37.055 } <sup>6</sup>
2, 5-dichloro nitro-benzene (Powder)	37.22	..	..	37.874 } <sup>6</sup>
	35.48	..	..	35.921 }
,, (Single crystal)	37.23	29.34	1.26891	..
	35.48	27.96	1.26895	..
2, 3-dichloro nitro-benzene	36.02	..	..	..

The two lines observed for compounds (2) and (3) may be due to different environment of "Cl" in the molecules. On this basis we can expect two lines for compound (4) also but the second line could not be observed at room temperature.

Further work on the Zeeman effect of single crystals in these compounds is in progress.

The author is deeply indebted to Prof. K. R. Rao for his kind and invaluable guidance during the course of this work. He is very grateful to Dr. C. R. K. Murty for his valuable help and constant encouragement and to Dr. D. V. G. L. Narasimha Rao for several helpful discussions.

Physics Department,  
Andhra University,  
Waltair, April 4, 1962.

V. NAGARAJAN.

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CHARACTERISTICS OF SPORADIC E  
ECHOES OVER TIRUPATI

For some time now we have been interested in this low latitude laboratory (Geomagnetic latitude  $03^\circ 45' \text{N}$ .) on a study of the sporadic E. In an earlier communication<sup>1</sup> a report was made of observations on signals received from medium wave stations of the A.I.R. These studies are now extended and observations are made with a local pulsed transmitter working in the region of 1.5 to 15 Mcs. The period covered by this series of observations is June to September 1961. Observations are made at specified hours (a) early morning before sunrise, (b) sunrise and immediately after sunrise and (c) afternoon and evening hours. At each sitting amplitudes of  $E_s$  reflections are measured at a fixed frequency and at intervals of 3 seconds, the observations lasting over 10 to 15 minutes. From such observations, amplitude distribution curves are drawn by standard methods and compared against Gaussian, Rayleigh or Rice distributions.

Typical curves of observations are shown in Fig. 1. Generally early morning observations conform to Rayleigh distribution characteristic of reflections from an ion cloud. Sunrise observations have a typical Gaussian distribution characteristic of a thin layer. On some days this type of ionization is found to persist for quite a few hours after sunrise (*viz.*, 7 to 8 a.m., I.S.T.). Afternoon and evening observations

show a Rice distribution appropriate to a mixture of a predominantly thin layer superposed over with clouds. On certain days in the afternoon, the distribution is Rayleigh, typical of patches and such intense patches are found to last over a period of 20 to 25 minutes. It is interesting to note that our observations lead to conclusions which are more or less similar to the ones reported by Chatterjee<sup>2</sup> working at Calcutta (Lat. 22° 33' N.).

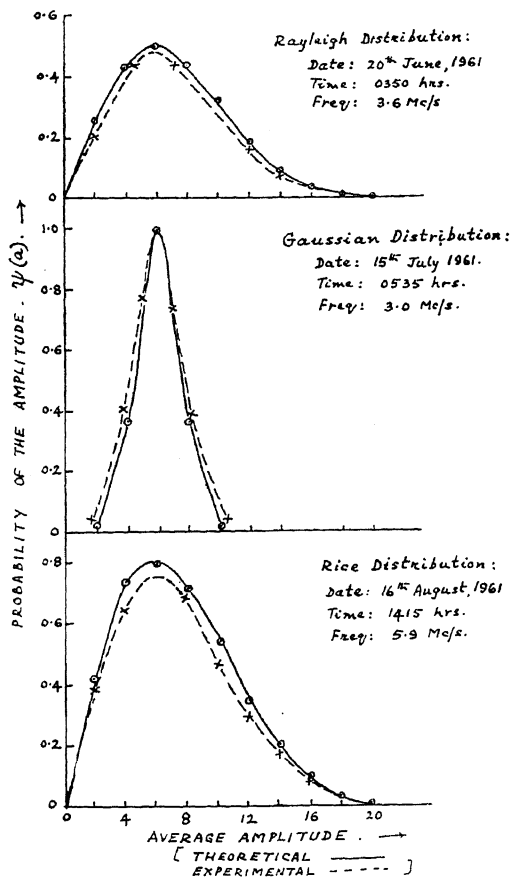


FIG. 1

I take this opportunity to thank Dr. J. Bhimasenachar for his guidance and encouragement. My thanks are also due to the authorities of Sri Venkateswara University for providing facilities and for the award of a scholarship.

Physics Department, M. J. KESAVA MURTHY.  
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## MAGNETIC ANISOTROPY OF MIXED CRYSTAL OF $\text{CuSO}_4 \cdot 2 \text{K}_2\text{SO}_4 \cdot \text{ZnSO}_4 \cdot 6 \text{H}_2\text{O}$

VAN VLECK<sup>1</sup> and Bose *et al.*<sup>2</sup> have pointed out that in crystalline Tutton salts of iron group of elements of the type  $\text{MSO}_4 \cdot \text{R}_2\text{SO}_4 \cdot 6 \text{H}_2\text{O}$ , where  $\text{M} = \text{Cu}, \text{Ni}, \text{Co}, \text{Fe}$ , etc., and  $\text{R} = \text{NH}_4, \text{K}, \text{Rb}, \text{Cs}$ , etc., the electric field arises out of an axially distorted octahedral cluster of water dipoles surrounding the  $\text{M}^{++}$  ion and the direct and induced effect of charges outside this primary cluster. The intensity and asymmetry of this field, which depend on the distribution of electric charges, will determine the magnetic anisotropy of the ion. When Tutton salt crystals are magnetically diluted, by partially replacing the  $\text{M}^{++}$  ion by  $\text{Zn}^{++}$  or  $\text{Mg}^{++}$ , the charge distribution is likely to be nearly the same for the different concentrations of  $\text{M}^{++}$  ion in the mixed crystal. As a result the magnetic anisotropy per gram of the  $\text{M}^{++}$  ion should be nearly independent of concentration in the mixed crystal.

Joglekar<sup>3</sup> measured the magnetic anisotropy of mixed crystals of  $(\text{NH}_4)_2\text{Cu}, \text{Zn}(\text{SO}_4)_2 \cdot 6 \text{H}_2\text{O}$  but failed to detect the effect of magnetic dilution on magnetic anisotropy. Bleaney *et al.*<sup>4</sup> from paramagnetic resonance experiments found that for diluted crystals (ratio  $\text{Zn} : \text{Cu}$  is 50 : 1) the octahedron of water cluster about  $\text{Cu}^{++}$  ion is flattened while in undiluted crystals the octahedron is elongated. For a flattened octahedron,  $\text{K}_{||}$ , the magnetic susceptibility along the axis of symmetry of the water cluster is smaller than  $\text{K}_{\perp}$ , that normal to it.

In order to test this point we have measured the magnetic anisotropy of mixed crystals of cupric Tutton salt of the type  $\text{A} + n\text{B}$ , where  $\text{A} = \text{CuSO}_4 \cdot \text{K}_2\text{SO}_4 \cdot 6 \text{H}_2\text{O}$  and  $\text{B} = \text{ZnSO}_4 \cdot \text{K}_2\text{SO}_4 \cdot 6 \text{H}_2\text{O}$  and  $n$  represents the number of molecules of B associated with one molecule of A in the mixed crystal, by the well-known method of Krishnan and Banerji.<sup>5</sup> The absolute susceptibility is measured by a microbalance devised by Neogy and Lal.<sup>6</sup> The results of measurement are given in Table I.

According to the optical absorption findings of Mookherji and Chonkkar<sup>7</sup> a cubic crystal field having a positive coefficient splits the ground state of  $\text{Cu}^{++}$  ion into a doublet and a triplet separated by  $12380 \text{ cm}^{-1}$  while the tetragonal separation is  $400 \text{ cm}^{-1}$ . The mean magnetic moment  $\bar{\mu}$ , under this condition, is given by

$$\bar{\mu} = 3 \left[ 1 - \left( \frac{2}{3} D_0 + 1.46 \times 10^{-4} \right) (\lambda - kT) \right]$$

where

$$D_0 = 4/\Delta E_{||} - 1/\Delta E_{\perp} \text{ cm}^{-1}; \Delta E_{||} \text{ and } \Delta E_{\perp}$$



TABLE I

Crystal	Percentage of Cu <sup>++</sup> ion	$\Delta\chi = \chi_1 - \chi_2 \times 10^6$	$\Delta\chi = \chi_1 - \chi_3 \times 10^6$	$\Delta K = K_{II} - K_I$ $\times 10^5$	$\bar{\mu}_B$	$D_0 \times 10^4$ cm. <sup>-1</sup>
A+ .97B	51.8	293	59.37	526.6	1.969	2.02
A+ 1.97B	33.5	310	61.4	558.5	1.976	2.15
A+ 4.36B	18.57	314.7	59	569.0	1.977	2.18
A+15.04B	6.21	391.9	75	-466.9	1.76	-1.79
A+39.48B	2.46	405.7	93	-498.7	1.75	-1.91

are the energy differences of the lowest basic doublet and two tetragonal levels respectively of the triplet.

Now taking  $\lambda = -828.7$  (Shenstone and Wilet<sup>8</sup>) and our  $\bar{\mu}^2$  values we have evaluated  $D_0$ , which are shown in Table I. It is seen that at a concentration 6.21% of Cu<sup>++</sup> ion,  $D_0$  becomes negative. This is very significant; for according to Bose *et al.*,<sup>2</sup> the magnetic anisotropy of the paramagnetic unit is connected to  $D_0$  by the relation,

$$K_{II} - K_I = 2N\beta^2/kT (-\lambda + kT) D_0$$

Thus a change of sign of  $D_0$  from positive to negative makes  $K_{II}$  less than  $K_I$ , and hence at a concentration 6.21% of the Cu<sup>++</sup> ion at 300° K. the octahedron of water cluster about Cu<sup>++</sup> ion becomes flattened in complete agreement with paramagnetic resonance findings.<sup>4</sup>

It is further significant that  $\Delta K$  when evaluated from  $\Delta\chi$  values taking  $K_{II}$  greater than  $K_I$  gives almost the same value as for undiluted salts (Bose *et al.*<sup>2</sup>) up to a concentration 18.57% of Cu<sup>++</sup> ion for which  $D_0$  is positive. For concentration for which  $D_0$  is negative  $\Delta K$  has double the value if  $K_{II}$  is taken greater than  $K_I$ , but value of the undiluted salt is obtained when  $K_I$  is taken greater than  $K_{II}$  (Table I).

Details will be published elsewhere.

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May 4, 1962.

### ISOLATION OF A NEW LEUCOANTHOCYANIDIN FROM THE SEEDS OF *MUSA ACUMINATA* COLLA

CONSIDERABLE importance is attached to banana as a fruit. There are large variations in the physical and chemical characteristics of the innumerable varieties cultivated in the different parts of the world. Contributing to some extent to the astringency of certain portions of the fruit seems to be the presence of leucoanthocyanidins. In the course of extended studies of leucoanthocyanidin sources, we have examined a wild and heavily seeded variety of sweet banana, *Musa acuminata* Colla, found to some extent in Delhi but abundantly available in Bengal. The prominent seeds are markedly hard and since leucoanthocyanidins are generally associated with hard seedcoats, the seeds have now been examined in greater detail. They are rich in a leucoanthocyanidin, which exhibits novel features.

The leucoanthocyanidins of banana have earlier been examined by conversion into anthocyanidins followed by colour reactions or chromatography. *Musa sapientum* has been shown to contain leucoanthocyanins which give rise to delphinidin.<sup>1</sup> In this case, the leucoanthocyanin is contained in the fibres forming part of the meal. According to Simmonds,<sup>2</sup> leucodelphinidin and leucocyanidin are almost universally present in bracts, flowers, fruits, sheaths and leaves of all bananas. They are especially abundant in green fruits.

Nicholas,<sup>3</sup> while studying the occurrence of indolyl acetic acid in a seeded variety of banana (*Musa* species), found the presence of an unknown substance, which showed some resemblance to indolylacetic acid in giving a pink colour with ferric chloride-perchloric acid or *p*-dimethyl-aminobenzaldehyde-hydrochloric acid, but differed in *Rf* values and exhibited characteristic colour reactions of leucoanthocyanidins.

In our studies, the air-dried and powdered seeds of the wild and seeded variety

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*M. acuminata* were first extracted with petroleum ether and ether to remove the fatty and the waxy matter. Then they were exhaustively extracted with acetone in the cold. The acetone extracts were concentrated under vacuum and the syrupy residue obtained was dried in a vacuum desiccator. The leucoanthocyanidin was extracted from this residue by means of ethyl acetate and crystallised from a mixture of ethyl acetate and light petroleum.

The leucoanthocyanidin seems to be a single entity having the following characteristics. It is a pale brownish crystalline solid (small prisms) which darkens above 230° and does not melt up to 280°, and gives in circular paper chromatography, Rf 0.49 with butanol-acetic acid-water (4 : 1 : 5) (upper layer, 30°) and 0.92 (lower layer, 30°). With vanillin-hydrochloric acid, it gives a characteristic pink colouration. On acetylation it gives an acetate which melts at 166–172° with earlier sintering at 160°,  $[\alpha]_D^{25} -43.6^\circ$  (in ethyl acetate). Methylation of the leucoanthocyanidin with diazomethane gives a methyl ether, m.p. 223–26° (sinters 220°),  $[\alpha]_D^{25} -71.8^\circ$  (in ethyl acetate), which undergoes acetylation to give an acetate, m.p. 224–32° (shrinks 218°).

By the oxidation of the methyl ether with potassium permanganate, anisic acid is obtained whereas periodic acid oxidation gives anisaldehyde. Attempts to isolate the other degradation products from both the permanganate and the periodic acid oxidation have failed so far.

The anthocyanidin produced from the leucoanthocyanidin, by boiling with alcoholic hydrochloric acid, has circular Rf 0.58 in the lower layer and 1.00 in the upper layer of butanol-acetic acid-water (4 : 1 : 5) system and Rf 1.00 in phenol-water (lower layer). It has  $\lambda_{\max.}$  at 525 m $\mu$  which is not changed on the addition of aluminium chloride. In this, it is closest to pelargoinidin which has  $\lambda_{\max.}$  at 530 m $\mu$  and Rf 0.9 (phenol-water, lower layer), but is distinctly different from it. The fact that the absorption remains unchanged on the addition of aluminium chloride shows that the anthocyanidin, and therefore the leucoanthocyanidin is devoid of any orthodihydroxy system.<sup>4</sup>

The analytical values for the leucoanthocyanidin, and its derivatives, approximately correspond to a flavan-3 : 4-diol, with two phenolic hydroxy groups, but this is ruled out because the flavylum chloride obtained from the leucoanthocyanidin is not identical with any of the following four possible flavylum chlorides, obtained synthetically. (i) 3.5.4'-trihydroxy flavylum chloride,  $\lambda_{\max.} = 490 \text{ m}\mu$ ; (ii) 3.6.4'-

trihydroxy flavylum chloride,  $\lambda_{\max.} = 475 \text{ m}\mu$ ; (iii) 3.7.4'-trihydroxy flavylum chloride,  $\lambda_{\max.} = 485 \text{ m}\mu$ ; (iv) 3.8.4'-trihydroxy flavylum chloride,  $\lambda_{\max.} = 500 \text{ m}\mu$ . All these compounds absorb at or below 500 m $\mu$ . The higher absorption of the flavylum salt obtained from the leucoanthocyanidin indicates the presence of at least three phenolic groups in the leucoanthocyanidin. The analytical values, including the methoxyl value of the methyl ether, seem to correspond to a trihydroxy flavan-3, 4-diol, associated with an alkyl residue. The presence of an alkyl residue is also shown in the NMR spectrum of the leucoanthocyanidin methyl ether. There is a prominent signal at 8.7 $\tau$ , which indicates a C—CH<sub>2</sub>— or a —C—CH<sub>3</sub> group in the molecule.

It seems to be reasonable to conclude that the leucoanthocyanidin of banana seeds is a flavan-3, 4-diol and has a phenolic hydroxyl in the 4'-position (oxidation experiments), has a phloroglucinol system in the condensed benzene nucleus (vanillin-HCl colour, absorption max. of anthocyanidin) and has further an alkyl group (analytical values and NMR spectrum). It may therefore be an alkylated leucopelargoinidin. Work is in progress to find out the nature of the alkyl residue and its position in the molecule. All absorption spectra were taken in methanolic 1% HCl.

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Delhi-6, April 7, 1962.

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#### STABILITY OF VITAMIN B<sub>12</sub> IN MALT EXTRACT AND HONEY

THE stability of vitamin B<sub>12</sub> in aqueous solutions is known to be influenced by the presence of other B complex vitamins, vitamin C, 1–7 sugars<sup>1,8</sup> and amino-acids<sup>9</sup> in the solution. Multivitamin preparations, advocated as general tonics, are usually prepared in syrupy bases containing different types of sugars.

Malt extract forms a vehicle for many multivitamin preparations. Honey is also being advocated as a suitable base. The effects of these syrupy bases on the stability of vitamin B<sub>12</sub> have not been studied so far. This note summarises the results of our investigations in this field.

## MATERIALS AND METHODS

Malt extract (ITL) and pure honey (Bee-Keepers' Association, Sakaleshpur) have been used.

Vitamin B<sub>12</sub> estimations were carried by microbiological technique utilizing *Lactobacillus leichmannii* 313 as test organism.<sup>10</sup>

Both malt extract and honey were initially tested for vitamin B<sub>12</sub> activity. For the stability study sterile vitamin B<sub>12</sub> solution was added to 30% solutions of sterile bases—malt extract and honey—and distributed in sterile tubes. The retention or loss of potency has been studied under two conditions:

1. At room temperature at monthly intervals over a shelf life of six months, and,

2. By artificially ageing the mixture by treatment at 120° for half an hour.

## RESULTS

The actual loss and percentage effect are shown in Table I and Figs. 1 and 2. The results represent the average values of six experiments.

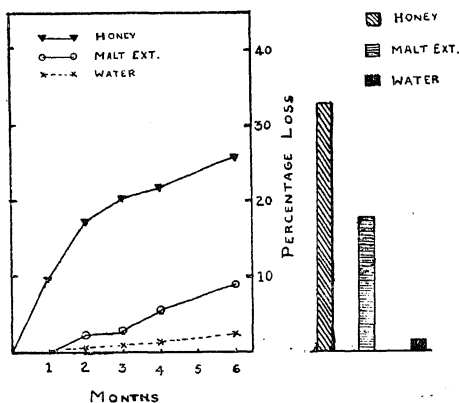
STABILITY OF VITAMIN B<sub>12</sub> IN MALT-EXTRACT & HONEY

Fig. 1. At Room Temperature.

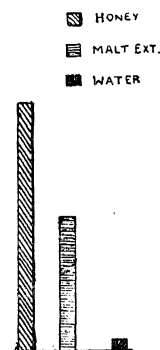


Fig. 2. At Elevated Temperature. (120° FOR 1/2 HR.)

No detectable amount of vitamin B<sub>12</sub> activity was found in malt extract and honey.

Malt extract, while causing about 17% loss of vitamin B<sub>12</sub> activity in artificial ageing at elevated temperature, exerts only a mild adverse effect at room temperature. No adverse effect is observed till the end of one month and then a gradual fall from 2–9% over a period of next five months is seen (Table I).

TABLE I

Stability of vitamin B<sub>12</sub> in malt extract and honey during storage and after autoclaving (figures indicate  $\gamma$ /ml.)

Vehicle	Initial conc.	Conc. after storage at the end of					After autoclaving at 120° for half an hour
		1 month	2 months	3 months	4 months	6 months	
Malt extract ..	5.26	5.26	5.14	5.09	4.96	4.79	4.33
Honey ..	5.57	5.02	4.60	4.40	4.36	4.13	3.79
Water only ..	5.25	5.24	5.21	5.20	5.18	5.13	5.18

Honey is more destructive than malt extract, both at high temperature and during shelf life at room temperature. At elevated temperature 34% destruction, almost double that of malt extract is observed. Nearly 10% loss within one month extending to 18% by the end of 2nd month and then a gradual rise to 26% over the next four months is the shelf-life deterioration.

The corresponding loss in water is negligible.

Our earlier studies on the stability of vitamin B<sub>12</sub> in sugar solutions have shown that both glucose and fructose cause considerable destruction of vitamin B<sub>12</sub> while maltose exerts a mild effect.<sup>11</sup> The vitamin B<sub>12</sub> stability in honey and malt extract can possibly be explained by the presence of invert sugars in the former and mainly maltose with negligible amount of glucose in the latter.

Our thanks are due to Mysore Industrial and Testing Laboratories, Bangalore, for the generous supply of malt extract.

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# POSSIBLE USE OF FOOD PREFERENCE OF AN INSECT PEST AS A FACTOR FOR ITS CONTROL IN A STORED COMMODITY

SPECIFICITY with respect to the infestation by insects in the commodities such as cereals, pulses, spices and milled products is commonly observed. The sequence of infestations by insect pests in the whole cereals and pulses differs widely with regard to taxonomic nature of the pests. Spices are attacked by a group of pests which are not normally found on pulses and cereals. The specificity indicated with regard to pest infestation on these commodities needs some fundamental considerations with a view to utilising this phenomenon in the control of stored grain pest. Repellency and attractance of chemicals to the arthropods of medical importance were subjects of interest and have been investigated very thoroughly. Dethier,<sup>1</sup> Roadhouse<sup>2</sup> and others<sup>3,4</sup> have screened through an array of chemicals for their repellency to Arthropod vectors of human diseases. There seems to be no report dealing with the action of different chemical repellents and spices on the stored grain pests. A preliminary investigation was therefore initiated in this laboratory with a view to determine the repellency of some spices to the pest of wheat semolina for its control.

Initially turmeric, cumin, coriander and pepper, the common spices used in India, were tested for their repellency or otherwise with *Tribolium castaneum* (Herbst.) as the test insect. These materials were powdered and passed through 40 mesh sieve and used at the rate of 5-2,500 p.p.m. on wheat semolina.

*T. castaneum* adults were drawn from laboratory cultures at random. Twenty insects were released in each plastic repellence testing plate containing the test material along with the control (Fig. 1). The plastic containers were kept away from light and incubated for 24 hours at room temperature (23-25° C.). Number of insects migrating to each area was counted periodically. There were 9 replications of each treatment. The results are given in Table I.

The results indicated that out of the materials tested cumin, turmeric and pepper had high degrees of repellency for *T. castaneum* adults. Coriander was a poor repellent for *T. castaneum*. It was indicated by the results that the test insect could be repelled by cumin, turmeric or black pepper at 500 and 2,500 p.p.m. concentrations in wheat semolina. Cumin at a low concentration of 5 p.p.m. showed slight attractance

as compared to the control semolina. *T. castaneum* adults which migrated on to the ground spices became moribund within the exposure period of 24 hours.

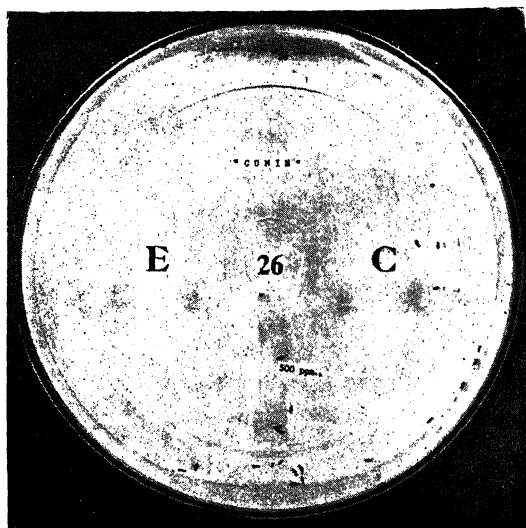


FIG. 1. Repellence testing plate used in the experiment. E=Treated side; C=Control side.

TABLE I

Repellency of *T. castaneum* adults to cumin, turmeric, pepper and coriander

Substance	Concentration		In	In	Spice only
	5	50	p.p.m. 500	semolina 2,500	
% Repellency and Range %					
Cumin ..	- 7*	23	77	73	83
	(-10 to 0)	(10 to 40)	(50 to 100)	(60 to 80)	(80 to 90)
Turmeric	30	0	57	70	97
	(20 to 40)		(40 to 70)	(60 to 80)	(90 to 100)
Coriander	27	22	22	23	28
	(-10 to 70)	(-10 to 55)	(20 to 25)	(20 to 30)	(20 to 35)
Pepper ..	10	10	60	70	77
	(0 to 20)	(-10 to 30)	(50 to 70)	(60 to 80)	(70 to 80)

$$\% \text{ Repellency} = \frac{C - E \times 100}{T}$$

where C = No. of insects in the control.

E = No. of insects in the experiment.

T = Total number of insects released.

\* Slight attractance was exhibited at 5 p.p.m. concentration of cumin in semolina.

Experiments with cumin and turmeric powders at different dosages to prevent cross-infestation in wheat flour and semolina bag stacks are in progress. Results so far obtained

have indicated that dusting of the bag surfaces with cumin or turmeric could serve as a prophylactic barrier for the control of *T. castaneum* in stored wheat flour and semolina.

Although specificities of *Sitophilus oryzae* for whole cereals, *Bruchus chinensis* for pulses, *T. castaneum* for milled grains and *Stegobium paniceum* for spices are commonly noted, these phenomena have not been utilized for repelling a particular species of stored grain pest. The present report seems to open up new possibilities for utilising specificities for substrates and food preferences of insect pests, as controlling factors against pests of stored commodities.

Authors are thankful to Dr. V. Subrahmanyam, Director and Dr. A. Sreenivasan, Deputy Director, for their keen interest in the programme of work.

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#### INVESTIGATIONS ON THE EFFECT OF MINERAL SALTS ON FAT SYNTHESIS BY *PENICILLIUM AURANTIOBRUNNEUM*

DURING recent years the question of the possible application in industry of the fat synthesising capabilities of various micro-organisms has aroused the interest of numerous workers and, in particular, studies undertaken by Lundin<sup>1</sup> with certain yeasts have attracted wide attention. The function of fat formation, like other specialised biochemical activities in moulds, is influenced mainly by two factors: (1) strain specificity; (ii) the particular environmental conditions imposed upon the organism. Mineral nutrients have also been reported to greatly affect the amount of fat produced by the mould *Aspergillus fumigatus*.<sup>2</sup>

The work reported here was undertaken to investigate the influence of trace elements on the fat synthesis by *P. aurantiobrunneum*. The medium composition, growth conditions, harvesting, extraction and estimation of fat were similar to those employed by Singh and

Ishwar Datt.<sup>3</sup> A range of different doses of each salt was tried and the optimum concentration has been recorded in Table I.

TABLE I  
Fat synthesis by *P. aurantiobrunneum* in the presence of different salts

Salt added	Wt. of salt g./100ml.	Wt. of felt g.	Wt. of fat g	Fat % of felt
Standard medium .. ..		3.3390 ( $\pm 0.109$ )	0.3530	10.57
$\text{Na}_2\text{MoO}_4$ .. 0.0050		3.2780 ( $\pm 0.101$ )	0.2996	9.15
$\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$ .. 0.0050		3.5090 ( $\pm 0.016$ )	0.3090	8.8
$\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$ .. 0.0100		3.5450 ( $\pm 0.079$ )	0.3254	9.18
$\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$ 0.0150		3.6320 ( $\pm 0.097$ )	0.4310	11.87
NaI .. 0.005		3.3140 ( $\pm 0.100$ )	0.3590	10.83

Incubation temp. 25° C. Period of incubation 16 days.

It is clear from Table I that although sodium molybdate, cobaltous chloride and barium chloride reduce, sodium borate and sodium iodide enhance fat synthesis by *P. aurantiobrunneum*. A detailed report will be published in a later communication.

Results and calculations are based on 50 ml. of the medium per 250 ml. conical flask.

The author is greatly indebted to Dr. J. Singh for the advice and help.

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#### SPOT TEST FOR CADMIUM IN THE PRESENCE OF COPPER

MANY spot tests<sup>1,2</sup> are available for the detection of cadmium in the presence of copper. Most of them involve the use of exotic reagents and some of the hazardous KCN as well.

A simple spot test has been based on the fact that copper salt is immediately reduced to the red-brown copper (I) oxide<sup>3</sup> by an aqueous solution of phenylhydrazine hydrochloride. Traces of copper go into solution due to the inevitable presence of the strong acid. However, when spot test is applied, good separation results.

The blue solution of tetramines of copper (II) and cadmium was just acidified with 5N acetic acid to liberate copper ions. Two drops of freshly prepared 3% solution of phenylhydrazine hydrochloride in distilled water and a drop of the acidified solution were successively transferred to spot reaction paper of medium absorption. (White blotting-paper gives highly satisfactory results.) Copper (I) oxide always got isolated in a narrow area and cadmium spread out. On transferring 10% solution of  $\text{Na}_2\text{S}$  along the periphery, yellow outer circle of  $\text{CdS}$  was formed.

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### PHOSPHOLIPIDS OF THE SILKWORM *BOMBYX MORI* L.

THE compound lipids are being shown to be metabolically active forms of the fat in living tissues. Only a few reports are available on the phospholipid composition of insect lipids. Considerable differences, both qualitative and quantitative, in their composition have been observed.<sup>1-4</sup> The pupal fat of the silkworm *Bombyx mori* L. has a high percentage of phospholipid in that the amount eluted from a silicic acid column as phospholipid is of the order of 18.08%. This percentage is very high indeed when compared to those observed in other insects.<sup>2,5</sup>

Table I shows the analysis of the nitrogenous compounds comprised of 62.5% choline, 16.1% sphingosine, 8.1% serine and 3.67% ethanolamine. This is in contrast to the high percentage of ethanolamine found in the blowfly<sup>5</sup> and the extremely large amounts of sphingosine found in *Anthopleura elegantissima*.<sup>3</sup> Sphingosine takes the second place in abundance and this is in striking contrast to its complete absence in the blowfly.<sup>5</sup> The percentage of choline found in the silkworm closely corresponds to the amount found in liver lipids<sup>6</sup> and the phospholipids of serum.<sup>7</sup> The remaining 10% of nitrogen is made up of unidentified amino-acids. Chromatographic analysis of the acid hydrolysate of the lipid sprayed with ninhydrin gave seven clear

bands. Inositol was detected by the spot test of Feigl.<sup>8</sup> A series of bands were observed on chromatogram run for sugars and sprayed with either diphenylamine reagent or triphenyl tetrazolium chloride reagent; one of them corresponded to glucose and the other to maltose. Two bands remained unidentified although a strong one at the origin indicated to the possibility of it being a polysaccharide. Neither the amino-acid bands nor the sugar bands could be observed in the unhydrolysed lipid and they resisted removal by repeated washings.

TABLE I  
(mg. of nitrogen/gm. of lipid)

Total nitrogen	Choline <sup>9</sup>	Sphingosine <sup>10</sup>	Serine <sup>11</sup>	Ethanolamine <sup>11</sup>	Unknown
4.568 mg.	2.8553	0.7343	0.3691	0.1674	0.442

Choline and sphingosine were estimated in the lipid hydrolysed with 6 N HCl for 24 hours and also in the barium hydroxide hydrolysate.<sup>10</sup>

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# CO-EXISTENCE OF GREEN SCHIST FACIES AND GRANULITE FACIES IN THE KAREPALLI AREA, ANDHRA PRADESH

Karepalli area (Lat. 17° 28'; Long. 80° 13'), met District, Andhra Pradesh, was by the officers of the Hyderabad Geosurvey as granite and was supposed to give into Pakhals (Mahadevan, 1949). In geological mapping of the area, the found that the Karepalli rocks show ble diversity in lithology, consisting of these granulites, hornblende granulites, orthopyroxenes, etc. The granulites are somewhat and the foliation strikes roughly with a dip of 70° to 80° due east. In with the granulites there are green schists throughout the region. The foliation of these is parallel to that of the adjacent schists.

## MINERALOGY

Hypersthene granulites are fairly unmineralized. The feldspars are white or pinkish, quartz is colourless and the matrix is black. Under the microscope small amounts of biotite, garnet and orthopyroxene may be noticed as accessories. Hypersthene is strongly pleochroic with X pink and Z green. It shows inclined foliation of 10° to 12°. Plagioclase has the composition of An<sub>20-25</sub>. Potash feldspar is more abundant than plagioclase. Antiperthite is common. The hornblende granulites are pinkish and dark-coloured since both biotite and quartz are greyish. The optical characters of hornblende are X = yellow green, Y = dark green; Z = dark green; 2V = 65°. These are more or less similar to those found in hypersthene granulites. The green schists show plenty of chlorite and epidote with orthopyroxene. Along the foliation planes of these, pink feldspars are often noticed. Under microscope, the feldspar is found to be occurring both in the ground mass and in the phylloids. It is intensely sericitized. There is a ferriferous green variety. Chlorite is a massive prochlorite.

Association of albite, epidote and actinolite suggestive of green schist facies of the type of Verhoogen (1960) and epidote and orthopyroxene facies of Eskola (1920) to some extent. The mineralogical assemblage of hypersthene, quartz, garnet and perthitic feldspar, and the granulites are indicative of granulite facies metamorphism. The co-existence and

intermingling of both the facies in the field cannot be explained on the basis of Eskola's facies concept reflecting an environment of different P and T conditions. Such a coexistence could be explained on one of the two following factors:

(a) Change in bulk composition of the original sediments now represented by the green schists and granulites. Presence or absence of water would exert a great influence and cannot be disregarded in bulk composition (Yoder, 1952).

(b) Metasomatism acting in conjunction with metamorphism.

The former view is supported by Yoder (1952) who says that "changes of a few per cent. in composition (including the oxide, water, H<sub>2</sub>O) may produce a great change in mineralogy. What was interpreted by Eskola and others as a change in P and T conditions may actually be, for the most part, the result of a change in bulk composition". In detailed field and laboratory investigations of the Karepalli rocks it is found that such an explanation is to some extent quite likely, the green schists representing rocks originally rich in water and the granulites deficient in water. But another reason appears to be the onset of granitization metamorphism on orogenic metamorphism (Misch, 1949). The author could trace in the field the evolution of hypersthene granulites from garnetiferous biotite schists, the hornblende granulites from epidiorites and so on. In both the evolutionary series, textural studies reveal that plagioclase replaces the mafic biotite and hornblende, and in turn it is replaced by potash feldspar, that is, a soda front followed by a potash front. Hence such metasomatic sequences acting on variable sediments could give rise to different kinds of metamorphic rocks and no standard set of mineralogical assemblages denoting distinctive facies could be expected. This is ably expressed by Read who says that "any standard set of metamorphic zones or facies is unlikely to be produced if granitization were to be connected with regional metamorphism. The variables are too many and diverse, the composition, structure, texture and grain size of the rocks, pressure and temperature and the nature and kind of metasomatizing solutions; there may be charnockitic migmatization in a dry environment and amphibolitic in a wet". The co-existence of green schists and granulites in Karepalli area amply corroborate the above views of Yoder and Read.

The author is grateful to Prof. Hans Ramberg of the University of Chicago and Dr. S. Balakrishna of the Osmania University, for their

valuable suggestions throughout the investigation.

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### PRIMARY ORGANIC PRODUCTION OFF WALTAIR COAST

MEASUREMENTS of primary organic production of the sea, as gauged by rate of photosynthesis using the isotope  $C^{14}$ , instead of the more conventional oxygen technique, received impetus in the present decade. Except for observations from a few scattered stations in the Bay of Bengal during the Galathea Expedition<sup>7</sup> no data are available on the primary production from the seas around India.

As a part of our programme of planktological studies we carried out recently a few experiments on primary organic production employing both  $C^{14}$  and oxygen methods at a fixed station located on the 10 Fathom line in Lawson's

Bay, off Waltair. A few experiments were also carried out at 5 stations located between the 18-23 Fathom lines off this coast on board the Fishery Trawlers operated by the Government of India. All the productivity experiments of 6 hours duration were carried out *in-situ* under natural illumination.  $C^{14}$  ampoules of 0.004 mc. strength supplied by the Central agency for  $C^{14}$  determination Charlottenlund Slot, Charlottenlund and membrane filters, Grob, Stufe 2 (0.8  $\mu$ ) from Membranefiltergesellschaft, Gottingen, were used. The experimental details of filtration, processing and counting are the same as detailed in Nielsen's publications.<sup>6-7</sup> No corrections were made either for the respiratory losses or for the organic matter excreted by algæ. The hydrographical data using standard methods and productivity data are presented in Table I.

It has been clearly established from our earlier investigations<sup>3-4</sup> that the plankton production on the East Coast of India attains a primary maximum during March-April period and a secondary maximum during October-November period. It is fortuitous that the Galathea data cover the major peak period and the present data cover the minor peak period. Judging from the Galathea data for station 303 (a typical coastal station) it may be inferred that the magnitude of the organic production during the primary peak is more than twice the secondary peak. The results presented in Table I show that the inshore waters are more productive than the offshore waters. The hydrographical data suggests that the southerly

TABLE I  
Showing the hydrographical and productivity data

St. No.	Date	Depth of sample m.	Surface temperature °C.	pH	Turbidity $SiO_2/l$	$SiO_2$	$O_2$ ml./l.	Inorganic $PO_4$ $\mu g.$ at/l.	Silicates $\mu g.$ at/l.	Dark and light bottle tech. Mg. $C/M^3$ , 6 hours		$C^{14}$ tech. primary production Mg. $C/M^3$ , 6 hours	Total amount of $CO_2$ assimilated by Algae Mg. $C/M^3$ , 6 hours	$O_2/C^{14}$
										Gross	Net			
1	23-10-1961	0	29.0	8.2	9.8	18.37	6.67	0.77	42.5	426.9	248.8	7.30	657.00	0.649
2	30-10-1961	0	29.0	8.4	8.7	20.23	6.67	1.32	40.0	870.0	0.0	6.48	583.20	1.491
3	13-11-1961	0	27.2	8.4	6.5	22.94	6.20	0.66	42.5	490.3	155.7	6.15	553.50	0.885
4	22-11-1961	0	26.4	8.2	1.7	25.46	6.67	0.53	12.5	777.5	31.09	5.50	504.00	1.543
5	17-11-1961 A	0	26.46	8.4	3.3	24.56	5.81	0.82	7.5	310.9	311.00	4.43	398.70	0.779
6	17-11-1961 B	0	26.20	8.4	1.25	24.56	6.66	0.88	10.0	621.9	311.00	2.32	238.50	2.978
7	17-11-1961 C	0	26.20	8.3	2.20	25.28	6.12	0.80	7.5	171.8	171.80	2.19	197.10	0.871
8	17-11-1961 D	0	27.10	8.2	2.00	25.64	6.32	0.82	7.5	31.1	31.09	2.19	197.10	0.157
9	25-11-1961 E	0	26.30	8.2	1.70	25.64	5.63	0.53	10.0	1057.3	995.09	0.636	51.40	19.435
10	25-11-1961 E	15.3	..	..	2.35	25.64	5.57	0.42	10.0	590.8	0.0	0.942	89.80	6.579
11	25-11-1961 E	30.5	..	..	2.50	32.79	5.57	0.66	16.0	*	*	0.372	33.50	..

1 to 4 Lawson's Bay and 5 to 11 Offshore Stations;

\* Samples were lost in the sea.



current brings about greater dilutional effects in the inshore region than the offshore as could be judged by the higher concentration of silicates, phosphates and low salinity values in the former region. The increasing salinity values during November indicate the gradual diminishing effect of the southerly current. The vertical productivity data are in conformity with the well-established view that the centre of organic production in the tropics lies at about 20 m. depth but not right at the surface. From the  $C^{14}$  data, the total amount of carbon assimilated by algae is calculated by employing Doty and Oguri's formula (1958) in order to compare the values obtained by the two methods. An extremely good agreement was found between these two methods as could be judged by the limited range of  $O_2/C^{14}$  values. Ryther (1954) found a good agreement between these two methods for the coastal tropical ocean waters in the Antillies Current, North of Puerto Rico, whereas the discrepancy of almost 200 fold was observed in the open ocean.

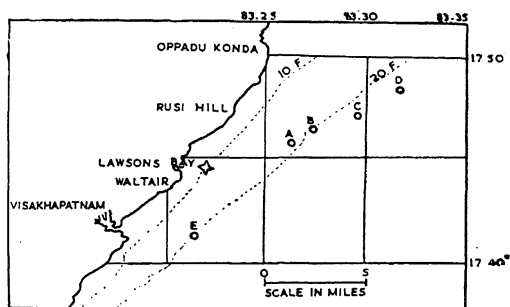


FIG. 1 SHOWING THE LOCATIONS OF THE STATIONS OFF WALTAIR COAST

We are grateful to Prof. Swami Jnanananda, Head of the Nuclear Research Laboratories, for giving us all facilities and to his colleague Sri. D. L. Sastry, for help in measurements of Radioactivity of the samples. We also thank the Officer-in-charge, of the Offshore Fisheries Station, Government of India, for providing facilities on board the Trawlers for carrying out the experiments. One of us (D. V. S.) gratefully acknowledges the National Institute of Sciences of India for the award of a Junior Research Fellowship during the tenure of which the present work was carried out.

Department of Zoology, D. V. SUBBA RAO.  
Andhra University, P. N. GANAPATI.  
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## THE SYSTEMIC CONTROL OF BLAST DISEASE OF RICE

BLAST, caused by *Piricularia oryzae* Br. et Cav., is a serious disease of rice wherever it occurs, except in irrigated tracts with a dry climate.<sup>4,5</sup> In India, it causes heavy losses especially in Madras, Mysore, Andhra Pradesh, Coorg, and Bombay, and various methods of its control are adopted.<sup>3</sup> Attempts towards systemic control of the disease with copper sulphate, silicic acid, and cephalothecin have been reported<sup>1,2,8,9</sup> while Watanabe<sup>7</sup> suggested the use of a vaccine obtained from the blast fungus. In the present paper are described results of experiments conducted with urea, thiourea, sulphanilamide, griseofulvin, and para-nitrophenol, all of which have often been reported to give systemic control of various plant diseases.

Plants of a susceptible variety, Adt<sub>10</sub>, were raised in liquid culture at 15-18° C. nycto-temperatures, so as to predispose them to infection.<sup>6</sup> The chemicals were supplied in selected dosages at the age of 10 days, and 4 days later, the middle half of the youngest leaf was inoculated by brushing with a spore suspension of the fungus (1-1.5 million spores/ml.).

Observations on phytotoxicity of the chemicals, as exhibited by the yellowing of foliage and/or general growth of treated plants, showed that thiourea at 100 µg./ml. was very toxic. Para-nitrophenol, sulphanilamide, and griseofulvin were little phytotoxic at the concentrations used, the toxicity of the chemicals decreasing in the order given. The higher concentration of a chemical was more toxic, if at all, than its lower concentration. Urea was apparently not phytotoxic.

Blast lesions developed on the plants within 4 days of inoculation. Both typical and atypical lesions—often mere necrotic specks, invisible to the naked eye, and representing a hypersensitive reaction—were produced. While very little browning of the lesions was noticed in untreated plants and those treated with urea, the lesions on sulphanilamide and para-nitrophenol treated plants were usually dark to intense brown. In plants treated with thiourea and griseofulvin, none or very few typical lesions were observed

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(Table I). The fungus was re-isolated from a majority of both typical and atypical lesions in all treatments. From 50–200 lesions of both types were measured (under the low power of a microscope) in the various treatments and their average size is given in Table I.

TABLE I

Effect of various chemicals on the number and size (mm.) of blast lesions on rice variety Adt<sub>10</sub>.

Chemical	Con- centra- tion (µg./ml.)	Expt. 1*		Expt. 2†	
		Number ‡	Size	Number ‡	Size
No chemical	..	8	3.0×0.9	14	4.2×0.4
Urea	..	25	6 3.6×1.0	12	4.7×0.6
	100	7	3.5×1.3	13	3.6×0.6
Thiourea	..	25	0 2.0×0.1	0	2.0×0.1
	100	0	2.0×0.04	0	2.0×0.1
Sulphanilamide	..	25	6 2.7×0.8	6	2.8×0.8
	100	4	0.2×0.1	6	0.4×0.1
Griseofulvin	..	10	3 2.0×0.7	3	3.4×0.9
	25	1	1.7×0.5	2	5.0×1.0
Para-nitrophenol	1	6	3.2×0.8	4	5.0×0.8
	5	6	2.3×0.4	4	3.8×0.4

\* 4 days after inoculation. † 10 days after inoculation. ‡ Number of typical lesions per leaf. § Size of atypical lesions only. ¶ Very few atypical lesions were noticed.

It will be noticed that considerable reduction in lesion size was effected by thiourea at both levels and sulphanilamide at 100 µg./ml. The other chemicals were not so effective in this respect. The number of typical lesions was reduced in all cases, especially in plants treated with thiourea and griseofulvin. The effectiveness of the chemicals wore off with time. This work indicates the possibility of systemic control of blast of rice with some of these chemicals.

I thank the University of Madras for permission to work in the University Botany Laboratory, and Prof. T. S. Sadasivan, Director of the Laboratory, for guidance. I also thank Dr. K. B. Lal and Dr. P. R. Mehta, for permission and encouragement to undertake the work.

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Quarantine and Storage,  
Plant Quarantine and Fumigation Station,  
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\* Originals not seen.

## THE PERSISTING NUCLEOLUS OF *ALLIUM CEPA*

DURING an attempt to demonstrate the presence of a limiting membrane for the nucleolus<sup>1</sup> it became necessary to distinguish it from chromatin. The chromatin associated with the nucleoli may occur in patches or as an uninterrupted border. The chromosomes often penetrate into the nucleolus.<sup>2</sup> Though the nucleolonema<sup>3</sup> have been surmised to be "chromosomal RNA",<sup>4</sup> they have also been suspected to be the chromosomal loops.<sup>5,6</sup> The presence of large amounts of DNA in isolated rat liver nucleoli have also been reported.<sup>7</sup>

The nucleolus originates in association with specific chromosomal loci<sup>8</sup> and may surround a chromosomal segment<sup>2,9</sup> or the SAT-filament. This association between the nucleolus and the organizer is said to be rather firm<sup>10</sup> and once it is lost the nucleolus generally disintegrates and disappears from view.<sup>11</sup> Nucleoli sometimes persist till meta-, ana- or telophases.<sup>4,10,12–14</sup> Such persisting nucleoli may be free, or may retain their association with all or only one of the SAT-chromosomes (Photos 2, 3 and 17 of Meenakshi and Subramaniam<sup>14</sup>). Since persisting nucleoli offer possibilities of an elucidation of the actual nature of their association with the SAT-chromosome, some observations in this context are presented below.

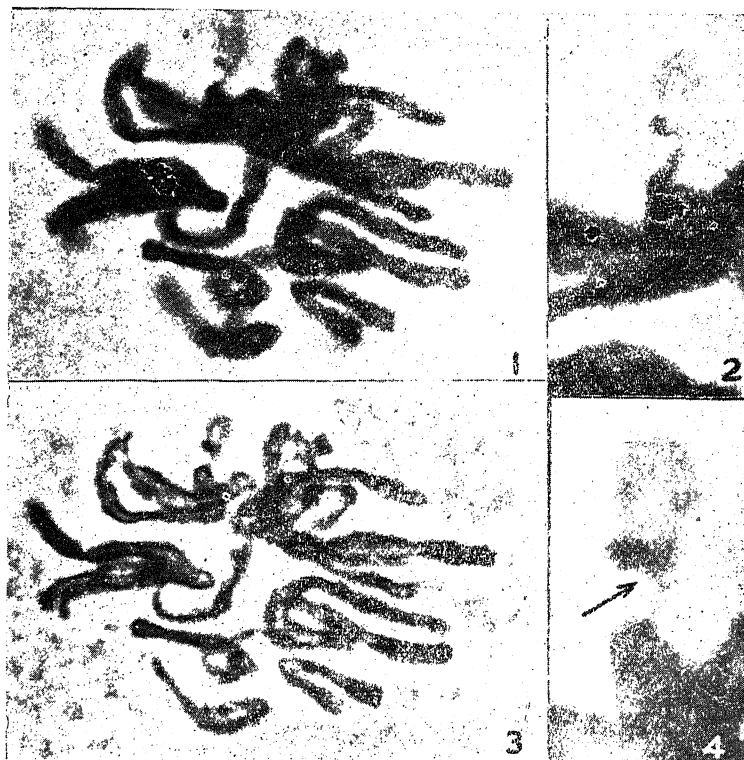
The nucleoli of the meristematic cells of *Allium cepa* could be stained with Giemsa<sup>15</sup> in paraffin sections of acetic alcohol fixed material. The structural details of the nuclei and chromosomes are superposable in hæmatoxylin and Feulgen squashes of fresh roots hydrolysed in N HCl at 60°C. for 8 min. The nucleoli, however, were unstained.<sup>16</sup> If acetic alcohol fixed material is hydrolysed in N HCl at 60°C. for 6 min., washed in water for 10 min., mordanted in 4% ferric ammonium sulphate for 10 min. and then squashed in a drop of aceto-carmin, the nucleoli were not stained.

Such experiences probably led other workers to incorporate formaldehyde into the fixative<sup>17</sup> or mordant the acetic alcohol fixed material with formaldehyde<sup>18</sup> to stain the chromosomes

and the nucleoli with Feulgen-aceto-carmine-fast green<sup>10</sup> or with aceto-carmine alone. It was thought interesting, therefore, to elucidate whether a storage of the acid hydrolysed roots in the mordant for 24 hrs. would lead to a staining of the nucleolus with aceto-carmine.

nucleolus retains its association with only one of them.

The position of the persisting nucleoli in relation to the spindle has intrigued investigators.<sup>11</sup> Is it possible that only those retaining their attachment to the SAT-thread even by a



PHOTOS 1-4. Photos 1-2. Ordinary illumination,  $\times$  ca, 1,900 and 4,100. Photos 3-4. Phase contrast,  $\times$  ca, 1,800 and 6,000.

The nucleoli were stained only in certain regions of a squash. In the preparation from which the photographs are presented the persisting nucleolus alone was stained. Photo 1 is of a metaphase plate under ordinary illumination. An enlargement to reveal the association of a nucleolus to a SAT-chromosome is presented as Photo 2. The clarity is better under phase contrast. Photo 3 is of the same metaphase plate and critical evidence for the continued association of the nucleolus and the SAT-chromosome is illustrated in Photo 4. The vacuole in the nucleolus is seen in the photos. The SAT-thread seems to be embedded in the nucleolar substance (indicated by an arrow) while the SAT-grain is outside it. Though there are a pair of SAT-chromosomes, the persisting

thin strand of nucleolar matter remain in the spindle?

Grateful acknowledgment is made to Dr. M. K. Subramaniam for counsel and to the authorities of the Indian Institute of Science and the C.S.I.R. for encouragement.

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**POLYSIPHONIA ACUMINATA N.L.  
GARDNER—A NEW RECORD FOR THE  
INDIAN OCEAN**

AMONG the algal collections from Okha Port, Gujarat, India, a plant which agrees with the description of *Polysiphonia acuminata* N. L. Gardner is found. It is a new record for the Indian ocean. The taxonomic features of the alga are given below.

Plants filamentous, up to 6 cm. tall, in tufts, attached by prostrate axes of limited growth. Rhizoids arising 1-2 from the distal end of the pericentral cells of both the prostrate axes and the basal part of erect axes, unicellular, separated by a cross-wall from the pericentral cells, at times with terminal irregular attaching discs. Erect axis bearing spirally arranged branches of higher orders, these terminating in more or less corymbose clusters of branchlets. Percurrent axis 165-270  $\mu$  in diam. Segments in the rhizoid bearing region either as long as wide, or slightly longer than wide, in the middle region as long as wide or up to 1.5 times longer than wide, and in the upper part as long as wide or slightly wider than long. Branches 1-8

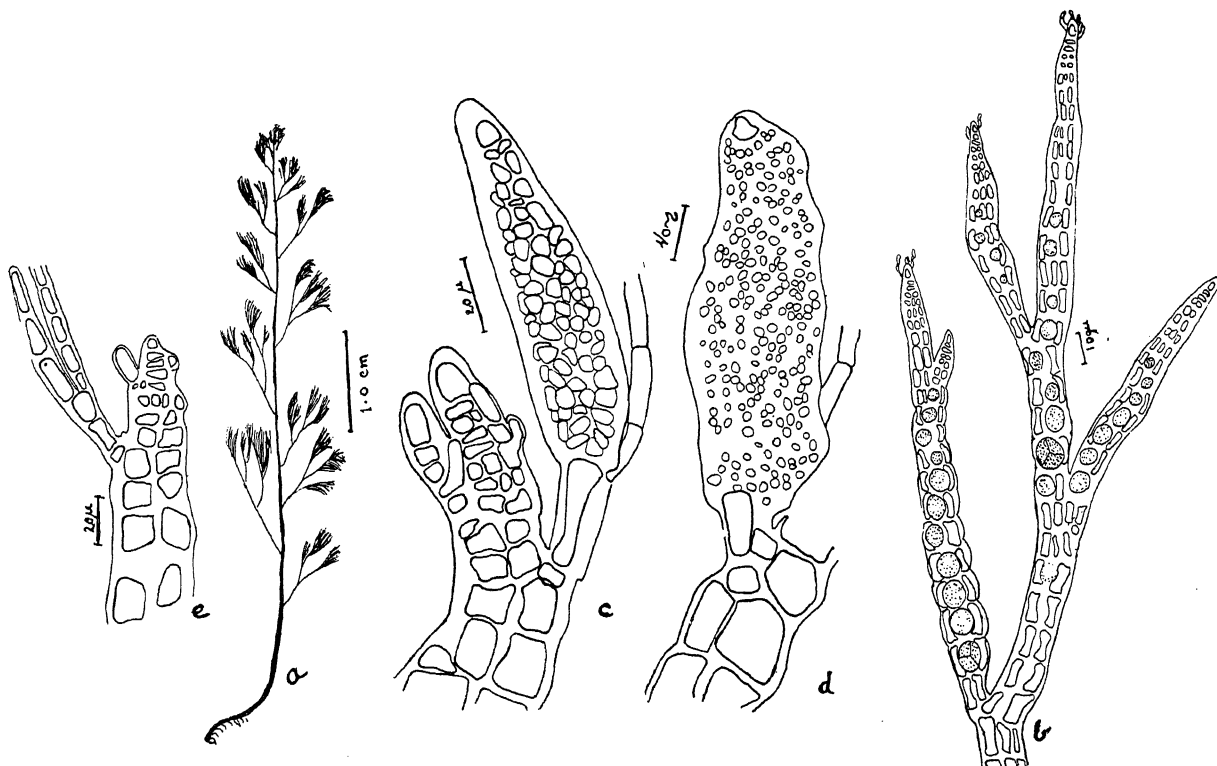


FIG. 1- *a-c*. *Polysiphonia acuminata* N. L. Gardner, *a*. Habit (Diagrammatic), *b*. Portion of filament showing tetrasporangia. *c*. Apical end with young antheridium. *d*. Mature antheridium showing sterile apical cell. *e*. Apex showing trichoblasts.

segments apart, replacing trichoblasts, branchlets nearly  $75\mu$  diam. at the base,  $105-108\mu$  in the middle, gradually becoming narrower to  $45\mu$  or slightly less at the apex. Plants tetrasiphonous, totally ecorticate. Trichoblasts, up to  $300\mu$  long, 1-2 times forked, absent in 3-4 lowermost segments of the branches, deciduous leaving scar cells in  $\frac{1}{4}$  divergence. Nodes swollen. Tetrasporangia  $39-50\mu$  ( $-66\mu$ ) diam.,<sup>8-12</sup> in spiral series, in slightly swollen segments of the terminal or subterminal branchlets. Antheridia  $33-43\mu$  diam.,  $63-149\mu$  long with one short sterile cell at the apex, arising from one fork of the trichoblast. Plants dark reddish-brown, adhering to paper on drying, blackish on drying.

Locality: Okha Port, 22nd January, 1961. Cast up with calcareous particles clinging to the rhizoids. Legit F. Thivy.

The Indian plant agrees very well with the description of *P. acuminata* established by Gardner (1927, pp. 100-101) and also with the descriptions given by Hollenberg (1942, p. 782) and Smith (1951, pp. 360-61). It has to be stated however that in the Indian plants the segments in part are less than one diameter and in part up to 1.5 diam. long. On the other hand in the Pacific plants they are reported by Hollenberg (l.c.) to be mostly less than one diameter, while Smith (l.c.) says that at the base of the shoot, the segments are longer than broad. There is resemblance between *P. acuminata*, and *P. uniguiformis* Boergesen (1937, pp. 53-55) in the presence of distinct percurrent erect shoots, but the former has a rhizoid-bearing prostrate filament while the latter lacks this. Further in the former, claw-like pairs of apical branches which are characteristic of the latter are absent. Besides, the presence of a sterile apical cell in the antheridium is characteristic for this species.

The writer wishes to express his indebtedness to Dr. (Mrs.) F. Thivy for her guidance. He takes this opportunity to thank Dr. A. N. Kappanna, Director, Central Salt and Marine Chemicals Research Institute, for his kind help and encouragement.

Central Salt & Marine      P. SREENIVASA RAO.  
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## CYTOGENETIC STUDIES IN INDIAN SILKWORMS

### II. Chromosome number in *Muga* silk-worm *Antheraea assamensis* Westwood

The genus *Antheraea* (family Saturniidae) has its centre of origin in the Indo-Malayan region. Its wild or semi-domesticated species provide the well-known tussar and muga silks of commerce.

Kawaguchi (cited by Makino, 1953 and 1956) has reported chromosome number of the Chinese tussar (*Antheraea pernyi* Guerin-Meneville) as  $n=49$  and of the Japanese tussar (*Antheraea yamamai* G.M.) as  $n=31$ . Apart from these, the chromosome numbers of over half a dozen Indian species of *Antheraea* are still unknown.

Testes from vigorous males of *A. assamensis* during their late larval or early pupal stages at various pre- and post-spinning periods ( $-7$  to  $0$  to  $+7$  days) were fixed in modified Bouin's fluid. They were then washed, dehydrated, cleared, infiltrated and embedded in paraffin as usual and sectioned at  $12.5$  microns, and were stained with crystal violet or modified haematoxylin.

Perceptible inception of meiotic activity starts by about seven days before the spinning of cocoons ( $-7$ ). Testes from males at the age of  $-5$  days usually show diplotene stages and metaphases occur in profusion in testes from  $-3$  age groups. The entire meiotic cycle terminates with the completion of cocoons though it may linger in isolated patches for about two to three days after.

Polar views of metaphases show 15 distinct bivalents as confirmed in a large number of instances. These fifteen bivalents, though usually equidistant, show an occasional tendency for secondary association. They show considerable differences in their relative sizes (Figs. 1-3).

*Antheraea assamensis* has  $n=15$  which is the lowest chromosome number reported so far among the *Antheraea* species.

*A. assamensis* is exclusively confined to the north-east corner of India particularly in the Brahmaputra river basin of Assam. Species of the closely related genus *Philosamia* Grote (*Attacus* Linn.), endemic in the same region, also show low chromosome numbers as  $n=13$  or  $14$  (Kawaguchi, 1937, Koga, 1939, both cited by Makino, 1953 and 1956; Deodikar and Thakar, 1958). It would appear that species of *Antheraea* and *Philosamia* with the lowest chromosome numbers are endemic in N.E. India particularly in Assam and the adjacent borders of Burma

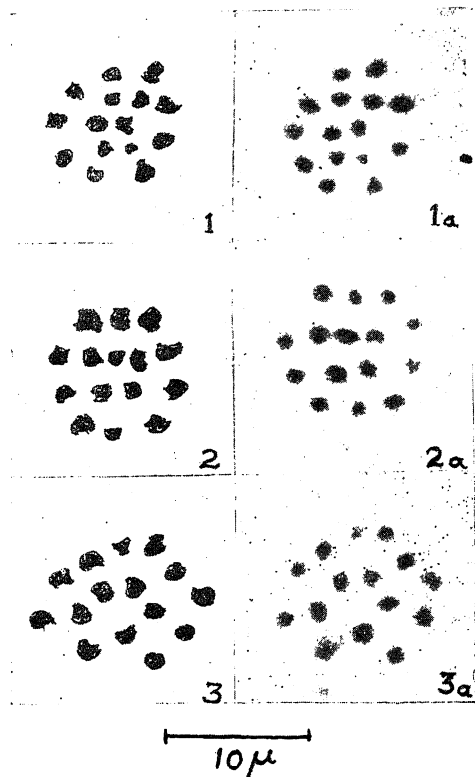
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and South China. Most of their natural food plants also occur as endemics in the same region. These regions thus constitute the *primary* centre of origin of these two genera of silkworms. From this primary centre of origin, they seem to have spread over other parts of the Indo-Malayan regions naturally and to other continents through recent introductions.

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### CYTOLOGICAL OBSERVATIONS ON SOME FERNS FROM SIMLA (WESTERN HIMALAYAS)

ACCORDING to Mehra<sup>1</sup> about 70% of the fern flora of the Himalayas has been cytologically investigated so far. These studies, however, largely pertain to the Eastern region and much of the flora of the extreme Western Himalayas has still to be investigated. Hence, cytological observations on the ferns of Simla (a popular health resort situated in the outer Himalayas at about 31° 6' N. latitude and 77° 10' E. longitude with an average altitude of 2,170 m.) were undertaken in 1960. This area falls within the territorial limits of "Flora Simlensis" by Collet.<sup>2</sup> Mostly haploid chromosome numbers have been determined during meiosis by aceto-carmine

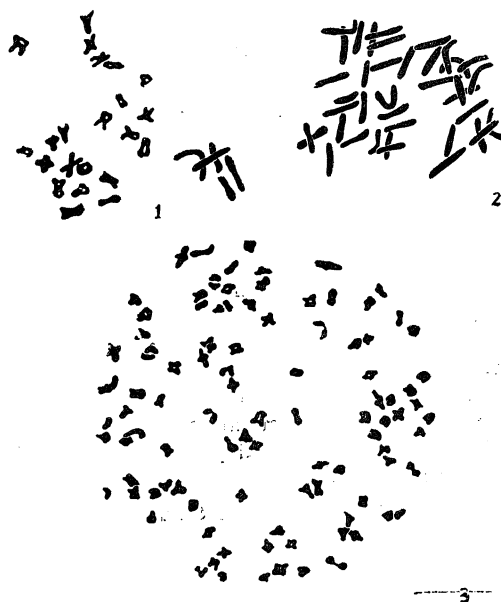


FIGS. 1-3. Spermatogenesis in *Antheraea assamensis* m-phase I showing 15 bivalents (Linear magnification 4,300,  $\times$  approx).

Investigations on comparative cyto-genetics and phylogenetic interrelations among the Indian genera of the family Saturniidae are in progress under a joint collaboration of the following institutions and the details will be presented elsewhere.

Grateful thanks are due to Sri. R. P. Phadke and Sri. S. R. Salvi, of the Agricultural Laboratories, Poona, for their valuable help.

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Sericultural Research,  
Station, Panchgani, November 28, 1961.



FIGS. 1-3. Fig. 1. Meiosis in spore mother cell of *Osmunda claytoniana*,  $n=22$ ,  $\times 1,300$ . Fig. 2. Mitosis in root-tip cell of *Osmunda regalis*,  $2n=44$ . These chromosomes have mainly median or sub-median constrictions,  $\times 1,300$ . Fig. 3. Mitosis in spore mother cell of *Sphenomeris chusana*,  $n=c. 100$ ,  $\times 1,300$ .

squash technique. The results are summarised\*  $n=30$  for *Dennstaedtia hirsuta* (Sw.) Mett. in Table I. from Japan and earlier Manton and Sledge<sup>3</sup>

TABLE I

No.	Name of the species	Locality	Chromosome Number	Grade of Ploidy
1	<i>Osmunda claytoniana</i> Linn.	.. Huttoo Peak, 3,150 m.	$n=22^{**}$ $2n=44$	Diploid
2	<i>O. regalis</i> Linn.	.. Chadwick Falls, 1,500 m.	$2n=44$	"
3	<i>Sphenomeris chinensis</i> Maxon	.. Tuti Kandi, 1,500 m.	$n=c. 100$	Tetraploid
4	<i>Dennstaedtia scabra</i> (Wall.) Moore	.. "	$n=33-34$	Diploid
5	<i>Araistegia pseudocystopteris</i> (Kze.) Copel.	Summer Hill, 2,100 m.	$n=40$	"
6	<i>A. pulchra</i> (Don) Copel.	.. "	$n=40$	"
7	<i>Leucostegia immersa</i> Wall.	.. Glen, 1,500 m.	$n=41$	"
8	<i>Oleandra walllichii</i> (Hook.) Presl	.. Glen, Chadwick, 1,500 m.	$n=41$	"
9	<i>Athyrium thelypteroides</i> (Michx.) Desv.	.. Narkanda, 2,680 m.	$n=40$	"
		Huttoo, 3,150 m.	$n=40$	"
10	<i>A. attenuatum</i> (Clarke) Tagawa	.. Phagu, 2,440 m.	$n=40$	"
		Huttoo, 3,150 m.	$n=40$	"
11	<i>A. schimperi</i> Mouge	.. Simla, 2,170 m.	$n=40$	"
		Narkanda, 2,680 m.	$n=40$	"
12	<i>Athyrium setiferum</i> C.Ch.	.. Chadwick Falls, 1,500 m.	$n=40$	"
13	<i>A. foliolosum</i> (Wall. ex Clarke) Bedd.	.. Huttoo, 3,150 m.	$n=40$	"
14	<i>A. rupicola</i> (Hope) C.Ch.	.. "	$n=40$	"
15	<i>A. macrocarpum</i> (Bl.) Bedd. (Pinnate and bipinnate types)	Chadwick Falls, 1,500 m.	$n=40$	"
16	<i>A. pectinatum</i> (Wall.) Presl.	.. Glen, 1,500 m.	$n=40$	"
		Tara Devi, 1,800 m.	$n=40$	"
17	<i>A. denigerum</i> (Clarke) Mehra et Bir	.. Huttoo, 3,150 m.	$n=40$	"
18	<i>A. Clarkei</i> Bedd.	.. Chadwick Falls, 1,500 m.	$n=40$	"
19	<i>A. japonicum</i> (Thbg.) Copel	.. "	$n=80$	Tetraploid
20	<i>Diplazium polypodioides</i> Bl.	.. Glen, 1,500 m.	$n=41$	Diploid
21	<i>D. spectabile</i> (Wall. ex Mett) Bir	.. "	$n=41$	"
22	<i>D. lobulosum</i> (Wall.) Presl.	.. "	$n=41$	"
23	<i>Asplenium varians</i> Hook. et Grev.	.. Summer Hill, 2,100 m.	$n=36$	"
		Huttoo, 3,150 m.	$n=36$	"
24	<i>A. dalhousiae</i> Hook.	.. Simla, 2,170 m.	$n=36$	"
		Luri, 600 m.	$n=36$	"
25	<i>A. unilaterale</i> Lamk. var. <i>delicatulum</i> Par.	Chadwick Falls, 1,500 m.	$n=40$	"
	var. <i>udum</i> Atk.	.. "	$n=40$	"
26	<i>A. trichomanes</i> Linn.	.. Summer Hill, 2,100 m.	$n=72$	Tetraploid
27	<i>A. planicaule</i> Wall.	.. Glen, 1,500 m.	$n=72$	"
28	<i>A. ensiforme</i> Wall.	.. "	$n=72$	"
29	<i>A. sarelii</i> Hook.	.. Summer Hill, 2,100 m.	$n=72$	"
30	<i>Woodwardia radicans</i> (L.) J. Smith	.. Phagu, 2,440 m.	$n=34$	Diploid
		Glen, 1,500 m.	$n=34$	"

\* Chromosome numbers of some more ferns were finalised after this note had been sent to the press. The results for these are as follows: (1) *Araistegia delavayi* (Bedd.) Copel. (enroute Huttoo, 2,700 m.)  $n=40$ , diploid. (2) *Athyrium fimbriatum* (Wall.) Moore (Huttoo, 3,150 m.)  $n=40$ , diploid. (3) *Athyrium anisopterum* Christ (Chadwick Falls, 1,500 m.)  $n=40$ , diploid. (4) *Athyrium nigripes* (Bl.) Moore (Huttoo Peak, 3,150 m.)  $n=40$ , diploid; and (5) *Asplenium fontanum* (L.) Bernh. (enroute Shali, 2,700 m.)  $n=72$ , tetraploid. The other three 'horsetails' worked out are: *Equisetum ramosissimum* Desf. var. *altissimum* A. Br. (near Tuti Kandi, 1,200 m.), *E. debile* Roxb. (Luri, 750 m.) and *E. diffusum* D. Don (Tuti Kandi, 1,500 m.). All of these are sexual with  $n=108$ . (Added at proof stage.)

\*\* Determined from material collected at Pahlgam; 2,250 m. (Kashmir).

All the ferns investigated here are sexual. In case of *Dennstaedtia scabra* (Wall.) Moore 33-34 bivalents were counted. From Simla-area this fern is diploid while earlier it was reported to be a tetraploid from Ceylon<sup>3</sup> ( $n=64-65$ ) and Eastern Himalayas<sup>4</sup> ( $n=66$ ). So this reveals the existence of two chromosomal races within the species. In the Himalayas, the diploids are smaller in size as compared to the tetraploids. Recently Verma and Kurita<sup>5</sup> have reported

counted  $n=94$  in *D. cicutaria* (Sw.) Moore. Britton<sup>6</sup> had reported  $n=34 \pm 1$  in *Dennstaedtia punctilobula* (Michx.) Moore. As the present data show, the genus *Dennstaedtia* is multi-basic with  $x=30, 32, 33, 34$  and 47 which indicates that this genus is an assemblage of diverse elements.

My thanks are due to Prof. P. N. Mehra for valuable suggestions and for providing facilities to visit Simla Hills.

Botany Department,  
Panjab University,  
Chandigarh-3, India,  
November 11, 1961.

S. S. BIR.

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### LOPHOTRICHUS AMPULLUS BENJAMIN FROM INDIA

*Lophotrichus ampullus* was first described by Benjamin<sup>1</sup> in 1949 on goat dung from Illinois. The fungus was found in this laboratory on decaying *Amaranthus* leaves and cotton in a moist chamber. The fungus has been brought into pure culture (Herb. R.U.B. No. 16).

On the natural substrate the fungus showed the following characters: perithecia submerged or partially exposed, spherical, with a short neck, brittle, dark brown, 220–231  $\mu$  in diameter. Neck 65–85  $\mu$  long, 35–37.5  $\mu$  wide. Tip of the neck pierced by an ostiole surrounded by long, non-septate appendages with uncinete tips and bulbous bases, 605–836  $\mu$  long, 6.6–7.1  $\mu$  wide at the base. Neck with hyaline, lateral, septate hairs with straight tips, 170–220  $\mu$  long, 6.0–6.6  $\mu$  wide at the base. Asci thin-walled, subglobose, evanescent, 8-spored, 20–27.5  $\times$  12.5–15  $\mu$ . Ascospores one-celled, subhyaline, lemon-shaped, 7.5–10  $\times$  5–12  $\mu$ .

The fungus was transferred to dung agar and on this medium perithecia were formed abundantly and matured in 14 to 18 days. Several mature perithecia from the culture were examined. The characteristics of the perithecial walls, evanescent asci, the light-coloured ascospores, and the manner in which ascospores were discharged in the form of an elongate cirrus were similar to what was seen with the fungus on the natural substrate. The appendages surrounding the ostiole, however, were septate in all these cases. This important feature together with others mentioned below permits classification of the fungus as *L. ampullus*. A description of the fungus grown in culture follows: perithecia spherical, partially exposed or submerged, when submerged with a very long neck, brittle, dark brown, 180–260  $\mu$  in diameter. Neck 126.6–189.9  $\mu$  long and 37.5–37.9  $\mu$  wide.

Tip of the neck pierced by an ostiole surrounded by long, brownish, septate appendages with thick walls and uncinete tips, 1.3 mm. long, 6.0–7.3  $\mu$  wide at the base. Hyaline, thin-walled, septate, lateral hairs with straight tips, 160–220  $\mu$  long, 6.0–6.6  $\mu$  wide at the base, surround the lower region of the neck. Asci thin-walled, subglobose, evanescent, 8-spored, 20.0–27.0  $\times$  13.0–15.2  $\mu$ . Ascospores one-celled, subhyaline, lemon-shaped, 7.5–10.0  $\times$  5.7–12.0  $\mu$  (Fig. 1).

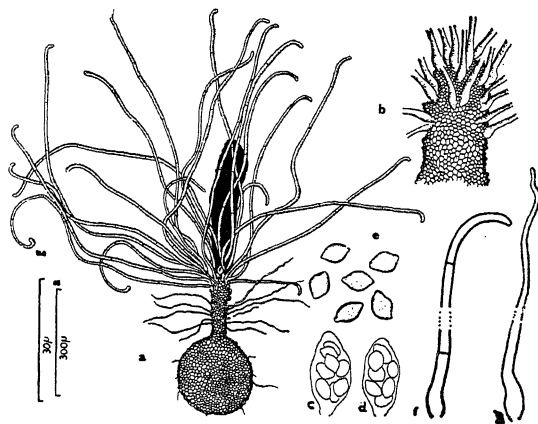


FIG. 1. *Lophotrichus ampullus* from Herb. R.U.B. No. 16. a, mature perithecia showing discharge of ascospores in a cirrus; b, neck region of perithecia enlarged showing attachment of terminal hairs with bulbous bases; c-d, asci with ascospores; e, ascospores; f, terminal hair with uncinete tip; g, lateral hair with straight tip.

We are grateful to Prof. C. V. Subramanian for guidance and to Dr. R. K. Benjamin for suggestions.

Department of Botany, N. G. NAIR.  
University of Rajasthan, O. S. CHAUHAN.  
Jodhpur, January 16, 1962.

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### ARGEMONE OCHROLEUCA SWEET SUBSP. OCHROLEUCA, A NEW RECORD FOR INDIA

The occurrence of *Argemone ochroleuca* Sweet subsp. *ochroleuca* in India was recorded for the first time by the author two years ago.<sup>1</sup> The more important morphological characters by which this newly recorded species can be distinguished from the better known *A. mexicana* L. are enumerated in Table I.

Of the three character differences enumerated in Table I, that of the stigma is particularly useful and by it alone the two species can readily



TABLE I

Character	<i>A. mexicana</i>	<i>A. ochroleuca</i>
Buds ..	Sub-spherical	Oblong
Petals ..	Bright yellow	Lemon-yellow
Stigma lobes	Broad, closely crowded together and appressed to the style	Narrow, spreading widely and revealing the non-receptive surfaces between them

be distinguished. Unfortunately this character is obliterated in herbarium specimens wherein the colour of the petals may also lose the distinctive difference that they show in living specimens. Ownbey,<sup>2</sup> in his monograph, states that *A. ochroleuca* is often confused with *A. mexicana*, much of the confusion arising from the study of only pressed specimens. Failure of authors of Indian floras to recognize the specific distinctiveness of the two taxa is perhaps also ascribable to the same cause.

Besides the floral character differences enumerated in Table I, the two species are distinguishable from each other in a number of more or less well-defined vegetative characters so that individuals of the two species can readily be told apart even at the seedling stage. However, F<sub>1</sub> hybrids between the two species which sometimes occur in nature<sup>3,4</sup> are difficult to recognize from vegetative characters alone.

It is difficult to state where and how *A. ochroleuca* first gained foothold on Indian soil. Probably it has come to India more recently than *A. mexicana*. Since it does as well as the latter species, it may be surmised that if allowed sufficient time, it may become as widespread as *A. mexicana* in this country.

Department of Botany, C. S. VENKATESH.  
University of Delhi,  
Delhi-6, December 31, 1961.

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#### SOME OBSERVATIONS ON THE MORPHOLOGY AND BIOLOGY OF *CLEOME CHELIDONII* LINN.

*Cleome chelidonii* Linn. has so far been designated as a marsh annual. The author finds that it can thrive in a variety of habitats some of which can hardly be described as wet. In all these situations, it preserves its essential hydrophytic character, viz., the profusely lacunar pith

in the stem. The species is also a *hemikryptophyte* whose dormant buds can be induced to put forth shoots periodically by adequate watering throughout the year.

On the banks of the local Gorewada lake, the author has come across a different population (B) of the same species. This population is subsequently succeeded by the typical (A) plants. The most significant differences between the two populations may be tabulated as follows:

Species: *Cleome chelidonii* Linn.

	Population A	Population B
Growth season	July-September	May-June
Pith ..	Profusely lacunar; cells small	Normal; cells large
Petal colour ..	Rose-pink	Purple-pink
Filament colour	Violet	Yellow
Anther colour ..	Black or deep violet	White

Since both the populations grow in the same place, the only variable habitat factors are the moisture content and temperature of soil and air. The two populations have been found to retain their identity when grown experimentally under varying conditions of soil moisture. Further, the distinctive characters of each are hereditary, being expressed in plants grown from seeds. There is nothing in the structure and biology of the population (B), that is even remotely suggestive of a life adapted to water environment.

It seems, therefore, safe to suggest that the two populations are not *ecads*, i.e., mere environmental variations of similar genotypes. They may be called *ecotypes*, i.e., dissimilar genotypes differing from each other in genes connected with the physiological and morphological adaptations. Cytogenetical studies may reveal their exact taxonomic status.

Department of Botany, M. V. MIRASHI.  
College of Science, Nagpur,  
February 16, 1962.

#### SYNNEMATIUM JONESII, AN ENTOMOGENOUS FUNGUS NEW TO INDIA

SPEARE<sup>4</sup> described *Synnematium* based on *S. jonesii* parasitizing *Mezira emarginata* and *M. lobata* in Louisiana. The fungus is characterized by the possession of simple or branched synnema, the hyphae of which are terminated at the apex by subulate phialides bearing one-celled hyaline conidia covered with mucus. The fungus also produces sclerotia.

In an account of the fungus collected in the Americas, Mains<sup>2</sup> includes in the host list for the fungus, *Harpalus* sp. from California, *Pardomis* sp. from Columbia, *Philonthus* sp. from Maine and a large leaf hopper from Costa Rica. In these collections either synnema or sclerotia alone were present. Petch<sup>3</sup> has also reported collections of the fungus on *Pororeus simuans* from the Philippines, on *Basilides bipinnis* from Sierra Leone, on *Promecotheca bicolor* from Fiji, and on *Helopeltis* sp. from Belgian Congo, all having only sclerotia and no synnema. Kobayasi<sup>1</sup> has described *Synnematium graptopsaltriae* on *Graptopsaltria nigrofuscata* in Japan with long synnema, non-fasciculate terminal phialides and lacking sclerotia. Mains<sup>2</sup> states that such characters are all variations that occur in *S. jonesii*. This note adds *Udonga montana* Dist. (Pentatomidae) to the host list of this fungus and records this fungus for the first time from India.

*Udonga montana*, the stink bug, is known to occur in many coffee growing districts of South India in swarms normally on bamboo, but occasionally to move to coffee and shade trees and cause damage by virtue of their vast numbers.<sup>5</sup> In the current year, a single insect parasitized by a fungus was collected from Huvinkadu estate in South Coorg, where the insect was reported to occur on coffee in pest scale, and made available to the writers for examination and identification of the fungus. The following description is based on a study of this material.

Both synnema and sclerotia present; synnema simple, terete, up to 1 mm. long and 90  $\mu$  in diam., white at first later turning brownish-white, composed of parallel longitudinal hyphae terminated at the apex by hyaline, subulate phialides 28-59 (44.5)  $\times$  3.0-4.0 (3.4)  $\mu$ ; conidia acrogenous, oblong, hyaline to subhyaline in mucus, agglutinated to form spherical globules containing several conidia, 7.0-12.5 (8.5)  $\times$  2.5-4.0 (3.4)  $\mu$ ; sclerotia spherical to irregular, white at first, becoming brown later, with thick-walled cells, 90-190 (145)  $\mu$  in diam. Scattered phialides bearing conidia in mucus globules were noticed on the periphery of the sclerotia. Some of the sclerotia had germinated producing small initials of synnema (Fig. 1).

The fungus was disposed as *Synnematium jonesii* Speare. This identification has been confirmed by Mr. Elphick, Commonwealth Mycological Institute, England. The specimen has been deposited in the Herbarium of C.M.I., England, under Accn. No. IMI 90238.

Unlike the earlier collections reported from other parts of the world, the present collection bears both synnema and sclerotia, though the small size of the former could probably be ascribed to an early stage in development.

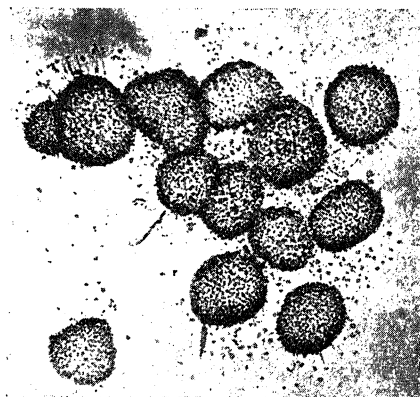


FIG. 1. *Synnematium jonesii* (About  $\times 75$ ). Sclerotia; two of the sclerotia have germinated producing initials of synnema.

The writers are grateful to Mr. Elphick, C.M.I., England, for help in definite identification of the fungus, to Dr. P. S. Sekhar, Entomologist, for placing the material at our disposal and to Dr. N. G. Chokkanna, Director of Research, for his keen interest.

Coffee Research,  
Station P.O.,  
Balehonnur (India),  
December 28, 1961.

T. R. NAG RAJ.  
K. V. GEORGE.

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# NATURALLY OCCURRING POLYPLOIDY IN *PUPALIA LAPPACEA*

*Pupalia lappacea* is a large straggling woolly undershrub with flowers in spicate clusters.<sup>2</sup> The plant is commonly found in hedges of fields and fruit orchards especially amongst the thorny shrubs.<sup>3</sup> While making a plant survey of Delhi State, we observed that the naturally occurring population of *Pupalia lappacea* can be classified into two distinct categories on the basis of length of spike. Although some members of *Amaranthaceae* have received the attention of

the cytologists,<sup>1,4,5</sup> no cytological work has been done on *Pupalia lappacea*. This led us to the cytological investigation of the two morphologically distinguishable forms of the species.

Young flower-buds were fixed in acetic-alcohol (1:3) for 24 hrs. The anthers were squashed in a drop of either acetocarmine or propionocarmine. The latter gave better results.

The pollen mother cells from plants with short spikes (Fig. 1, left) showed 24 bivalents

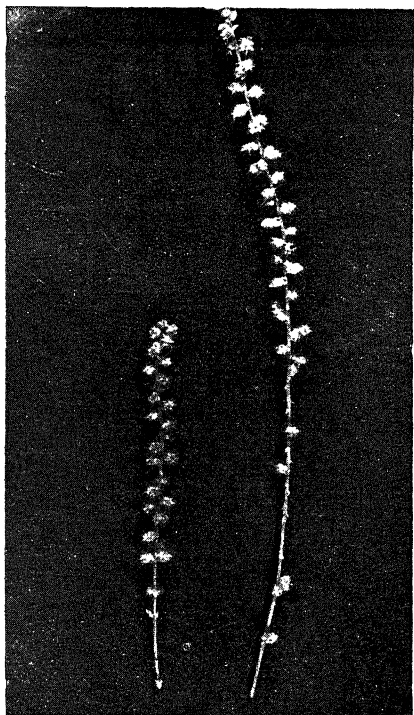


FIG. 1. Spikes of diploid (left) and tetraploid (right).

at diakinesis (Fig. 2, top). The distribution of chromosomes at anaphase I was quite regular, 24 chromosomes being clearly visible at either pole. The second division was normal. The plants with long spikes (Fig. 1, right) showed 48 bivalents at diakinesis and metaphase I (Fig. 2, bottom). The separation of chromosomes at anaphase I was also regular, 48 chromosomes going to each pole. The second divisional stages were without any irregularity. Meiotic studies in *Pupalia lappacea* have thus shown the existence of two cyto-types with  $n=24$  and 48. It may be mentioned that this is the first report of chromosome numbers in *Pupalia lappacea*.

The complete absence of multivalents and the presence of all the chromosomes in the form of bivalents at diakinesis and metaphase I suggest that the tetraploid in *Pupalia lappacea* originated

as a result of allopolyploidy. This is also supported by the fact that the tetraploid has a very high pollen fertility (98.00%) and as good a fruit and seed-setting as the diploid. High pollen fertility and good fruit and seed-setting are usually associated with allopolyploids. Excepting the long spike and long epidermal hairs on the leaves and slight increase in the size of the flower and the seed, the tetraploid showed no other morphological distinction from the diploid. Autopolyploids are, generally, characterised by gigantism. The absence of gigantism in the tetraploid *Pupalia lappacea* further goes in support of its allopolyploid nature.

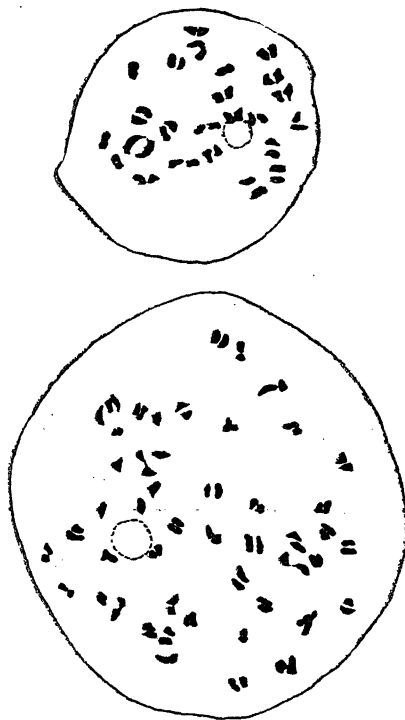


FIG. 2. Diakinesis showing 24 bivalents in the diploid (top) and 48 bivalents in the tetraploid (bottom).  $\times 1,900$ .

As the haploid chromosome number of twenty-four is rather high, it is difficult to consider this as the basic chromosome number of *Pupalia lappacea*. The family Amaranthaceae is reported<sup>1</sup> to have many basic chromosome numbers ( $x=6, 7, 8, 9, 10, 17$ ). From this it would appear that the original basic chromosome number of *Pupalia lappacea* was possibly six. Search for plants with  $n=6$  or 12 is being made.

The results reported in this note form part of the work of a research scheme sanctioned by the Council of Scientific and Industrial Research,

New Delhi. We are grateful to the Council for the financial assistance.

Department of Botany,  
University of Delhi,  
Delhi-6, January 1, 1962.

S. L. TANDON.  
G. R. RAO.

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#### A NEW PATHOGENIC SPECIES OF GENUS *CURVULARIA*

A SERIOUS leafspot disease of *Typha* sp. was observed at Allahabad in February 1960. The healthy leaves became chloronemic, turned pale yellow and ultimately developed light brown lesions. Isolations from the diseased foliage consistently yielded a species of *Curvularia* in culture. Two months later a very closely resembling species was isolated from the leaflets of *Cycas rumphii*, which also manifested almost similar symptoms on the host. Morphological studies revealed that the two organisms were absolutely identical. They differed from the known forms and had the following characters:

Conidiophores light brown, simple, unbranched, straight or bent, lateral or terminal, highly geniculate near the tip (Fig. 1), length

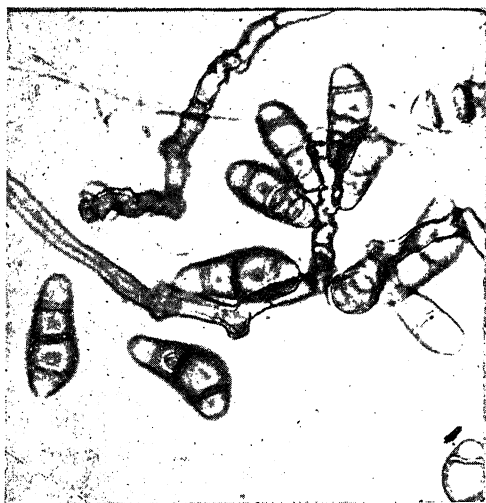


FIG. 1. Showing the conidia and conidiophores of *Curvularia verruculosa* sp. nov.,  $\times 680$ . variable,  $3-4.2 \mu$  broad; Conidia straight, fusiform or curved, brown, three-septate, no con-

striction of the point of septation. Third cell from the base bigger than others and sometimes curved. Basal cell hyaline while the rest are brown. Wall of the conidia very rough and verruculose;  $24.18 \times 11.96 \mu$  ( $20.8-26.0 \times 10.6-12.8 \mu$ ).

*Curvularia verruculosa* spec. nov.—Conidiophori pallide brunnei, recti vel flexi, alte geniculati prope apicem, longitudinis variabilis,  $3-4.2 \mu$  lati. Conidia insidentia ad apicem fere in simili plano efformantia catervam, recta, fusiformia vel curvata, 3-septata, septis latis, constrictione nulla ad septa. Cellula tertia a basi paulo maior, cellulis brunneis. Parietes conidorum distincte verruculosi; cellula basalis monstrat punctum unionis ad basim,  $20.8-26.0 \times 10.6-12.8 \mu$  (mediate  $24.18 \times 11.96 \mu$ ). In foliis *Typhae*, sp. et *Cycadis rumphii*.

On account of the presence of three-septate conidia, this species can easily be placed in the *Lunata* group. The detailed morphology of the fungus does not agree with any of the species of *Curvularia*<sup>1-3</sup> incorporated in the above group. The present isolate shows some resemblance with *C. trifolii* but can easily be distinguished from that species on account of the following peculiarities: (i) The conidial wall is rough and verruculose. (ii) The width of the conidiophore is lesser than in *C. trifolii*. (iii) The third cell from the base of the conidia of *C. trifolii* is darker in colour while the third cell of the present species is concolourous with the apical cell and the second cell from the base. (iv) The size of the conidia is smaller than in *C. trifolii*.

Due to these differences and verruculose nature of the conidial wall this species is designated as *Curvularia verruculosa* sp. nov.

The culture and herbarium specimens are deposited in Commonwealth Mycological Institute, Kew. Dr. Ellis of that Institute strongly feels that due to verruculose nature of the conidial wall this must be a new species.

The authors are grateful to Dr. J. C. F. Hopkins and Dr. Ellis of C.M.I., Kew, for their opinion and to Prof. H. Santapau for the Latin diagnosis.

Botany Department, R. N. TANDON.  
University of Allahabad, K. S. BILGRAMI.  
December 20, 1961.

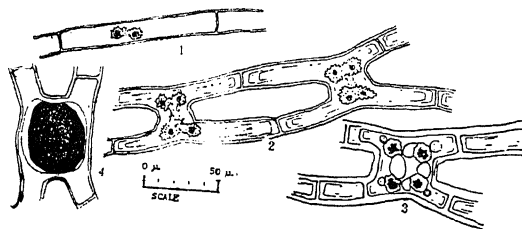
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**A NEW SPECIES OF ZYGNEMOPSIS  
(SKUJA) TRANSEAU, 1934  
FROM THE CALCUTTA—  
1961 NATIONAL AGRICULTURAL FAIR**

THE alga was collected from the freshwater shallow pool created by the artificial fountain near the second gate of the National Agricultural Fair, Calcutta—1961, at Taratola.

*Zygnemopsis queense* Das sp. nov., the species has been established in the following way:

**Cells** (Fig. 1): Cylindrical, length much greater than breadth. Protoplast contains two stellate chloroplasts with a single massive pyrenoid at the centre. Gametangium filled with dense pectic cellulose-colloid during reproduction. **Filaments** (Figs. 2 and 3): Unbranched, sexually reproduced by scalariform conjugation; zygote forming at the middle of the conjugating tube (Fig. 4). Lateral conjugation not observed.



FIGS. 1-4

No aplanospore found. **Thallus**: Free floating in masses, also submerged in freshwater, well aerated. Pale green in colour, to brown when mature. **Coll.**: C. R. Das, Calcutta-1961 Fair, 26-2-1961; C. R. Das and Dr. G. Mitra, Calcutta-1961 Fair, 10-3-1961. **Det.**: C. R. Das, 11-3-1961.

**DIAGNOSIS**

Cells, 80–120  $\mu$  by 12–18  $\mu$ . Zygotes, 40–65  $\mu$  by 35–50  $\mu$ .; quadrangular and round. Spore wall golden yellow, cytoplasmic remains present during reproduction.

Celluæ 80–120  $\mu \times$  12–18  $\mu$ . Celluæ genitivæ 40–65  $\mu \times$  35–50  $\mu$ .; quadrangulæ et globosæ. Monenium celluæ genitivæ aureus flavus, reliqua celluli genitivi qui hodie est.

**DISCUSSION**

It would be a new species of the genus *Zygnemopsis* distinguishable from the genus *Zygnema* at the reproductive phase having the cell contents being replaced by refractive pectic material, which may be smooth or lamellated. The specific name could be proposed as *Zygnemopsis queense* sp. nov., to record the historic visit of Her Majesty the Queen Elizabeth II of England at the National

Fair, Calcutta—1961 from where the species had been collected.

The author is grateful to Dr. G. Mitra for his help in the preparation of this paper. He is also thankful to Sri. N. C. Majumdar, and Sri Samaren for their encouragement.

Botanical Survey of India, C. R. DAS,  
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**INTRACARPELLARY POLLEN GRAINS  
IN FRITILLARIA AND LILIUM**

INTRACARPELLARY pollen grains were first observed in *Butomopsis lanceolata* (B.M. Johri<sup>1</sup>) and later in some other plants (see Puri; Adatia; Islam; Johri and Eunus; Eunus; Haque; Johri and Bhatnagar; Panchaksharappa<sup>2–10</sup>). During an investigation on the morphology of the gynoecium of *Fritillaria roylei* and *Lilium tigrinum*, I also observed a similar phenomenon which merits a brief report.

The gynoecia of *Fritillaria roylei* Hook. were fixed in formalin-acetic-alcohol from Hattoo (Narkunda, Simla Hills) in May 1961, and those of *Lilium tigrinum* Ker-Gawl. from Mussoorie in September 1960. They were processed in the usual way. Serial sections cut 8–17 microns thick were stained with a combination of safranin and fast green, or Heidenhain's hæmatoxylin alone or counter-stained with fast green.

***Fritillaria roylei***—In a cross-section the style shows a hollow, triangular canal which is widest just below the region of division of the style. The latter has three reflexed branches. The bicelled pollen grains were observed throughout the length of the stylar canal (Fig. 1), and occasionally in the ovary. Sections of a single style showed nine pollen grains. In two instances two pollen grains had germinated in the ovary in close proximity to the ovules (Fig. 2). It is to be noted that the average diameter of the stylar canal is 440 microns, whereas that of pollen grains varies from 30 to 40 microns.

***Lilium tigrinum***—The style is 15–20 cm. long and markedly curved. The stigma is papillate and has three ridges. The stylar canal is broadest just below the stigma and gradually narrows downwards. The pollen grains, which are bicelled, were observed not only in the



FIGS. 1-3.

Figs. 1-2. *Fritillaria roylei*. Fig. 1. Transection of a part of the style showing three pollen grains in the stylar canal; one on the extreme left shows signs of germination,  $\times 101$ . Fig. 2. Longisection of the upper part of

ovary; note a germinating pollen grain (arrow-marked) in the locule,  $\times 45$ . Fig. 3. *Lilium tigrinum*—Longisection of middle portion of ovary showing two pollen grains living adjacent to ovules (arrow-marked),  $\times 52$ . pg, pollen grain; pt, pollen tube; tt, transmitting tissue.

stylar canal but also in the ovary (Fig. 3). The mean diameter of the stylar canal is 2,500 microns and that of the pollen grains 55-70 microns.

How the pollen grains find their way into the stylar canal and ovary is not clear. Probably they are sucked into the ovary by some exudate from the stigma (see Sahni<sup>11</sup>). While the pollen grains mostly germinate on the stigma, they often germinate equally well on the surface of the style, in the stylar canal, or even in the ovary. In both the plants the cells of the stigmatic epidermis, stylar canal and the placental epidermis are papillate and generally uninucleate. In *Zephyranthes lancasteri* sometimes the pollen tubes may enter the style even through the stomata and make their way into the transmitting tissue (M. M. Johri, Unpublished). Whether the occurrence and germination of pollen grains in the stylar canal indicates any direct or indirect homology with plants like *Gnetum* (see Vasil<sup>12</sup>), where also the pollen grains sometimes germinate in the so-called micropylar tube, is difficult to interpret. With the present state of our knowledge perhaps we cannot attach any evolutionary significance to this phenomenon. Instead, it seems more important to initiate a detailed study of the structure of the style and stigma in relation to pollen tube growth.

I am greatly indebted to Dr. B. M. Johri and Professor P. Maheshwari for valuable suggestions and guidance.

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# BIOCHEMICAL RELATIONSHIPS OF HETEROTHALLISM IN *TRAMETES* *CINGULATA*

In the heterothallic hymenomycetes a tetrapolar species exhibits four types of mycelial reactions of the interacting primary mycelia.<sup>1,2</sup> These mycelial reactions have been designated in literature<sup>3</sup> as 'compatible', 'neutral', 'antagonistic' and 'inhibitory'. It has been assumed that in the case of tetrapolar species there are two allelomorphous pairs of sex-factors (A, a and B, b) in the fusion nucleus of a basidium and genetically four different types of nuclei (AB, Ab, aB and ab) are derived due to reduction division of the syncaryon in the basidium. Matings between primary mycelia forming dicaryotic stage will only take place so as to restore a double heterozygote,<sup>4</sup> viz., AB × ab AB × aB. The combinations of strains which fail to produce the typical heterozygote for the initiation of dicaryon behave in a peculiar way. Here are found two distinct kinds of reactions, viz., 'inhibition' and 'antagonism'. But so far, very little attention has been focussed to study the biochemical nature of the primary mycelia belonging to four sex-groups existing in tetrapolar hymenomycetes and to locate the biochemical expressions of these genetic differences.

With a view to study the free and bound amino-acids synthesized in the primary mycelial strains belonging to four sex-groups in *Trametes cingulata* Berk. (Polyporaceae), the transaminase systems existing in them, the effect of vitamin B nutrition and the enzymes produced by them, the present investigation was undertaken. Out of fifteen monosporous cultures originally isolated from a single sporophore for pairing experiments<sup>5</sup> and nuclear studies<sup>6</sup> the following four groups of primary mycelia were obtained: mycelia 3, 7, 11, 12 (ab); mycelia 1, 4, 10, 15 (AB); mycelia 5, 8 (aB) and mycelia 2, 6, 9, 13, 14 (Ab). All experiments in this context were carried out with primary mycelia from the above four sex groups.

The following observations were made:—

(1) *Amino-acids*.—None of the primary mycelia (15) was amino-acid-deficient and they produced identical amino-acids (both free and bound), as revealed by paper chromatography. Cysteine, aspartic acid, glycine, glutamic acid and valine were present in the free form, while cysteine, ornithin, lysine, aspartic acid, glycine, glutamic acid and valine were present in the bound form. Levels of these amino-acids were, however, not studied.

(2) *Transaminase*<sup>7</sup> *Activity*.—The same amino-acids, tyrosine, leucine, proline, valine and

aspartic acid (L-isomers), transaminated to α-ketoglutaric acid in presence of transaminases obtained from the primary mycelial strains of *T. cingulata*.

(3) *Vitamin B Nutrition*.—The effect of vitamin B nutrition of the primary mycelia of *T. cingulata* showed that none of the constituent B vitamins<sup>8</sup> had any direct or indirect effect on their growth characteristics. It might be that they are neutral to vitamin B nutrition.

TABLE I

*Enzymes produced by the primary mycelial strains of T. cingulata grown on mineral nutrient stock medium. Incubation period 12 days. Results average of triplicates*

	Enzymes tested for	Substrate	Presence of enzymes in primary mycelia			
			AB	Ab	aB	ab
1	Sucrase	.. Sucrose	+	+	+	+
2	Maltase	.. Maltose	+	+	+	+
3	Raffinase	.. Raffinose	+	+	+	+
4	Cellulase	.. Cellulose	+	+	+	+
5	Lactase	.. Lactose	—	—	—	—
6	Amylase	.. Corn starch	+	+	+	+
7	Inulase	.. Inulin	—	+	+	—
8	Pectinase	.. Pectin	+	+	+	+
9	Lipase	.. Methyl acetate	+	+	—	—
10	Pepsin	.. Blood fibrin	—	—	—	—
11	Trypsin	.. do.	—	—	—	—
12	Erepsin	.. Peptone	+	+	+	+
13	Urease	.. Urea	+	—	+	—
14	Asparaginase	.. Asparagine	+	+	+	+
15	Tanninase	.. Tannin	+	+	+	+
16	Ligninase	.. Lignin	+	+	—	—

+ Positive; — Negative.

(4) *Enzyme Production*.—The enzymes produced by the primary mycelia of *T. cingulata* *in vivo*<sup>9</sup> were not similar. It was significant that inulase, lipase, urease and ligninase were not present in all of them. Furthermore, the presence or absence of these enzymes seemed to be restricted to the two compatible groups. Inulase was present in one compatible group and absent in the other. Lipase, on the other hand, was present at one end of both the compatible groups. Same was the case with urease and ligninase.

It might, however, be possible that the production of lipase, ligninase and urease were due to genes that were only loosely linked to A and B respectively. Similarly, it might be argued that the original fruit body was heterozygous for a gene controlling inulase production and this gene was not linked to either A or B loci.

I am grateful to Dr. S. N. Banerjee, Department of Botany, University of Calcutta, for the encouragement in doing this work.

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### SOME OBSERVATIONS ON THE DEIGHTONIELLA FRUIT- AND LEAF- SPOT DISEASE OF THE BANANA

FROM the results of his studies on the three forms of the banana disease (development of 'black-spots' on the leaf surface, fruit-tip discolouration or 'black-tip' and 'fruit-spot' or 'speckle') caused by *Deightoniella torulosa* (Syd.) Ellis, recently Meredith<sup>2-4</sup> emphasized the importance of this fungus as an air-borne pathogen capable of causing serious damage under favourable conditions to the 'Lacatan' bananas in Jamaica. In India so far this fungus has been reported<sup>1,5</sup> [under the name *Helminthosporium torulosum* (Syd.) Ashby] on bananas from Assam and Madhya Pradesh. In the banana plantations near Visakhapatnam in Andhra Pradesh during the years 1960 and 1961 this disease was found to be most common and observations in the field revealed that out of the three types of infection mentioned above, the 'fruit-spot' or 'speckle' was the most common type. Some 'black-spots' on the leaves were also noticed, but 'black-tip' of the fruit was not observed. As recorded by Meredith<sup>2,3</sup> the intensity of spotting on the fruits varied with the age and the position of the fruit in the bunch. In many cases severe spotting was observed near the tip on the outer face and near the base on the inner face of the fruit, suggesting their development from the infection caused by the air-borne conidia deposited in these positions due to impaction.

Changes in the concentrations of the air-borne spores of *D. torulosa* were estimated from the catches on the slides exposed in a Hirst spore

trap kept with its orifice at a height of 6½ ft. above the ground level in a plot (devoted to rice cultivation) within 100 ft. from one edge of a two-acre plot of banana plantation throughout the year 1960. They were present in the air only from the middle of June till the beginning of November and even during this period they were caught only on fifty-three days. An examination of the weather records for this period indicated a close relationship between their occurrence in the air and the existence of wet weather. The highest concentration recorded in 1960 was 400/m.<sup>3</sup> on 26th September at 08.00 hrs. during a continuous damp spell which extended from 24th September. Although rainfall seemed to determine the presence of the spores of this fungus in the air, on days when they occurred they exhibited a regular diurnal periodicity with nil or extremely low concentrations during the night time. They appeared from 06.00 till 16.00 hrs. with a sharp peak recurring at 08.00 hrs. The diurnal periodicity curve shown in Fig. 1 is derived from the average values

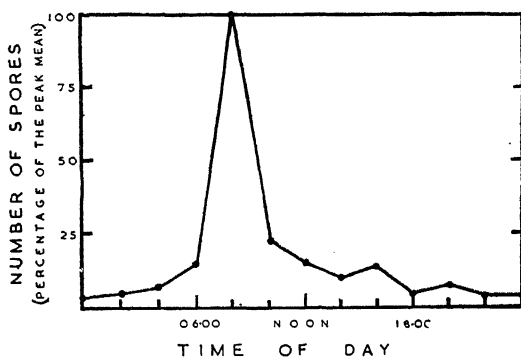


FIG. 1. Mean diurnal periodicity curve expressed as the percentage of the peak arithmetic mean concentration.

of the concentrations estimated at two-hourly intervals on all the fifty-three days in which spores of this fungus were trapped. The observations recorded at Visakhapatnam were in close agreement with the findings of Meredith<sup>3,4</sup> in Jamaica, but the very high numbers reported by him were not encountered here probably because of the smallness of the area of the plantation and the location of the spore trap away from the centre of the source. A correlation of the fluctuations in the number of air-borne conidia with the changes in the weather conditions and other aspects of the aerobiology of this fungus will be discussed elsewhere.



My thanks are due to Mr. A. Ramalingam for his assistance in spore-trapping and to Prof. J. Venkateswarlu, Head of the Botany Department, for his interest in this work.

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### A NOTE ON TWO INTERESTING FRESHWATER ALGAE FROM KERALA STATE, INDIA

THE two interesting algae, *Ecballocystis fritschii* var. *pulneyensis* Iyengar and *Tetrasporidium javanicum* Moebius, were collected by the author from Pallar river in Kottayam District, Kerala State, on January 19, 1959.

*Ecballocystis fritschii* var. *pulneyensis* Iyengar<sup>2</sup> (Fig. 1).—The thallus of this alga is spreading

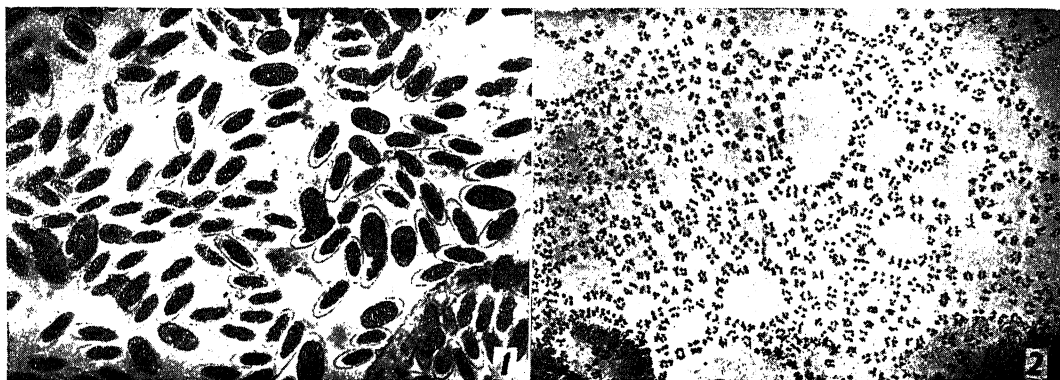
Reproduction is by simple vegetative cell division into two or sometimes four cells.

This alga was first reported by Iyengar<sup>2</sup> from a mountain stream at Kodaikanal in the Pulney Hills in South India.

*Tetrasporidium javanicum* Moebius<sup>3</sup> (Fig. 2).—The thallus of this alga forms a gelatinous two-layered green expanse. The two layers of the gelatinous matrix are continuous at the edges, but are separated by a hollow in the middle. In each layer, numerous perforations of varying sizes are seen. The cells are spherical or spherical-oval and measure 7.6–11.4  $\mu$  in diameter. Each cell has a cup-shaped chloroplast with a single conspicuous pyrenoid. Two small contractile vacuoles are seen at the anterior end of the cell. The cells lack an eyespot.

Reproduction is by simple vegetative division into two to eight cells.

This alga was first reported from India by Iyengar<sup>2</sup> from rain-water puddles at Madras and also from the sandy beds of the river Nagari in South India. It was subsequently reported from Jodhpur, Rajasthan State, by Bhandari<sup>1</sup> and from Punjab by Singh.<sup>4</sup>



FIGS. 1–2. Fig. 1. Photomicrograph of a portion of the colony of *Ecballocystis fritschii* var. *pulneyensis* Iyengar,  $\times 720$ . Fig. 2. Photomicrograph of a portion of the thallus of *Tetrasporidium javanicum* Moebius,  $\times 160$ .

and forms elliptic-oblong gelatinous cushions. The mother cell-wall of only one generation could be detected in the mucilaginous matrix, since there was rapid gelatinization of the cell-walls of the older generations. The cells are broader in the middle with sub-truncate ends. Each cell has two to eight, more or less curved, discoid, parietal chloroplasts, each containing a single large distinct pyrenoid with a clear starch sheath. At each end of the cell the protoplast has a colourless cytoplasmic area. The cells are 15.2–19  $\mu$  long and 5.7–9.5  $\mu$  broad.

This is the first record of these two algae from Kerala State.

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## REVIEWS

Lectures in Theoretical Physics, Vol. II. Edited by Wesley E. Brittin and B. V. Downs (Interscience Publishers, Inc., New York), 1960. Pp v + 483. Price \$ 9.00.

This volume contains the results of lectures delivered at the Second Annual Summer Institute for Theoretical Physics held in the Department of Physics at the University of Colorado. The lectures mainly deal with the current problems in elementary particle physics and field theory. The first lecture is by Abdus Salam on the 'Invariance Properties in Elementary Particle Physics' and deals with rotation groups in 2-, 3-, and 4-dimensions. In the second lecture, Sakurai deals with symmetry laws and elementary particle interactions. This chapter is devoted to a discussion of various topics such as parity, time reversal, charge conjugation, CPT theorem, invariance, etc. In the chapter on 'Many Body Problem in Quantum Mechanics,' N. M. Hugenholtz discusses the various methods developed to calculate the properties of the ground states and low-lying excited states of large systems of interacting particles. Finally in the chapter on 'Aspects on Abstract Field Theory,' Dr. M. Dresden discusses the current problems and difficulties in quantum electrodynamics and field theory.

The volume will be warmly welcomed by all research workers interested in quantum field theory and elementary particle physics.

K. S. V.

Structure Reports for 1954, Vol. 18. General Editor: A. J. C. Wilson. (Published for the International Union of Crystallography; by N. V. A. Oosthoek's Uitgevers MIJ Utrecht), 1961. Pp. 845. Price \$ 33.50; or £ 12.00.

Volume 18 of *Structure Reports* contains abstracts of all papers of structural interest published during the year 1954. As users of these volumes fully know, these reports are not mere abstracts but contain complete information on the materials concerned about unit cell, space group, atomic positions and parameters, inter-atomic and inter-molecular distances together with general discussions and references. The presentation of data is such that in many cases there may not be any need at all to consult the original papers so far as fundamentals of structural information are concerned.

The volume is divided into three main sections: Metals, edited by W. B. Pearson (pp. 1-332), Inorganic Compounds, edited by J. M. Bijvoet (pp. 333-828), and Organic Compounds, edited by J. Donohue (pp. 629-791). In the Metals section the arrangement is alphabetical. In the Inorganic and Organic sections, however, the compounds are taken in the order of increasing complexity of composition, related substances and related structures being kept together. Subject Index and Formula Index given at the end will facilitate easy reference. There is also an index of carbon compounds arranged primarily in the order of increasing number of carbon atoms, and secondarily by the number of hydrogen atoms. This will be appreciated particularly by organic chemists. Reports, somewhat of a more detailed nature, of papers in Russian and other journals not readily available, and even if available not easily understood, have been included and this is a welcome feature in this volume.

There is also a corrigenda which applies to previous volumes. The price, considering the excellence of printing and get-up, cannot be considered as too high. It is expected that the price now fixed will recover the cost of printing without looking to subventions. There is no need to mention that every X-ray and crystallographic laboratory should possess these volumes.

A. S. G.

Autoxidation and Autoxidants, Vol. I. Edited by W. O. Lundberg. (Interscience Publishers, Inc., New York), 1961. Pp. xiv + 450. Price \$ 15.50.

The book under review, the first of two volumes, attempts to cater to a wide spectrum of interests from the academically-minded industrial organic chemist to the biochemist. The major emphasis, not surprisingly in view of the nature of the subject, is on industrially useful processes.

Of the chapters which were of special interest to the reviewer were those on (i) Primary products of autoxidation by D. Swern; (ii) Physico-chemical aspects of autoxidation, and (iii) Mechanism of autoxidation by N. Uri; (iv) Autoxidation of various organic substances by L. Horner and (v) Photochemical autoxidation by R. Livingston. Swern and Uri between

themselves present a good exposition of the contemporary understanding of the reactions of free radicals in general and of autoxidation in particular. Horner has catalogued the interesting reactions undergone by different types of organic compounds. One notable omission in this article is the work of Salfeld (*Angew. Chem.*, 1957, 69, 723) on the mechanism of the oxidation of pyrogallol to purpurogallin. It was Salfeld who gave a rational mechanism for this complex transformation which has been verified in Horner's laboratory (C.A., 1960, 54, 16438). After a brief and illuminating discussion of the processes of light absorption, Livingston details the various photo-autoxidation reactions of anthracene and its homologues, of benzene derivatives and of olefins and the sensitized photo-autoxidations in solution. In the chapter on the analysis of autoxidation mixtures W. E. Link and M. W. Formo review the methods used for the analysis of the functional groups normally produced in autoxidation reactions, like the peroxides, carbonyl, hydroxyl, etc. Both classical methods and modern spectroscopic methods are discussed.

Other chapters are: Autoxidation of hydrocarbons accelerated by metals, light and other agencies by R. B. Mesrobian and A. V. Tobolsky; Autoxidation of Cholesterol by S. Bergstrom and B. Samuelsson; Autoxidation induced by ionising radiation by J. F. Mead; Biocatalysts by A. L. Teppel.

The book is largely free from errors and is warmly recommended.

S. K. BALASUBRAMANIAN.

**Technique of Organic Chemistry** (Vol. VIII, Part I)—*Investigation of Rates and Mechanisms of Reactions* (2nd Edn.). Edited by S. L. Friess, E. S. Lewis and A. Weissberger. (Interscience Publishers, New York 1, N.Y.), 1961. Pp. xii + 702. Price \$ 23.50.

The value of this comprehensive series on Technique of Organic Chemistry under the general editorship of Prof. A. Weissberger is well known. Investigations of reaction mechanisms have become one of the most important branches of physical organic chemistry, and the subject has been growing not only on the experimental side but also in regard to the theoretical interpretation of the results. From a practical point of view, detailed information on the rates and mechanisms of reactions can be most valuable in guiding operations and choosing optimum conditions for synthetic and for analytical work.

The great advances that have been made in the study of reaction mechanisms during the eight years since the first edition of this volume was published have called for a new edition of this treatise, rather than a reprinting only to meet the demand.

The new edition has been divided into two parts: Part I dealing with the kinetic methods, and Part II with very rapid reactions, and non-kinetic methods. In Part I which is under review, the following new chapters have been added: "Time measurements and recording of kinetic data" (Mac Nichol); "Interpretation of rate data" (Bunnett); "Use of computers" (Higgins); "Kinetic isotope effects" (Saunders); and "Heterogeneous reactions and catalysis" (Jungers and Balaceanu). The other chapters have been thoroughly revised and some of them rewritten by new authors.

This new and augmented edition should prove more useful than the earlier one both to inquiring students and the advanced research worker.

A. S. G.

**The Cell—Biochemistry, Physiology, Morphology.** Volumes IV and V. Edited by J. Brachet and A. E. Mirsky. (Academic Press, New York and London; India: Asia Pub. House, Bombay-1), 1960. Vol. IV—Pp. xv + 511. Price \$ 18.00; Vol. V—Pp. xv + 597. Price \$ 20.00.

In these two volumes, attention is focussed on specialised cells. Volume IV begins with an article on viruses by Rene Thomas wherein the main research lines in the field of virology is presented with a distinct bias towards bacterial viruses. The next chapter by Robinow on the visible organisation of bacteria gives in a nutshell the elements of bacterial cytology. The composition and function of the cell-wall, the mitochondrial function of the plasma membrane and some current problems concerning the nuclei of bacteria are all succinctly described. In Chapter III, Nanney and Rudzinska describe the problems of cellular regulation and cellular integration in ciliates and discuss the epigenetic and homeostatic mechanisms for the co-ordination of cellular activities. Hyden has contributed an article on the neuron in which our current knowledge of the morphology, chemistry and physical properties of the neuron is summarised and the role of nucleoproteins in neuronal function, discussed. In the next section Huxley reviews the available information concerning physiological, biochemical and structural aspects of muscular contraction. Particular emphasis is

given to a detailed discussion of the ultra structure of the contractile elements in muscle which can be described in terms of the 'interdigitating' or 'sliding filament' model. In addition to these, there are also chapters on Intracellular Parasitism and symbiosis and on Visual Photoreceptor structures.

The opening contribution by Gabe and Arvy in Volume V deals with the morphological, histophysiological and biochemical criteria of secretory activity in gland cells. Biochemical and electron microscopic investigations elucidating the active part played by the ergastoplasm in intracellular synthesis and the role of the Golgi bodies in the concentration and accumulation of the secretion products elaborated by the other organelles, are described in this article.

The selective transfer processes, involved in the regulation of the chemical composition of body fluids and the specialized cytological features of the renal tubule epithelium which underlie these processes, receive adequate treatment in the chapter on kidney cells by Forster.

In his article on Blood Cells and their formation, Marcel Bessis describes the morphology of the cells in the circulating blood, namely, the erythrocytes, lymphocytes, granulocytes and thrombocytes. The haematopoietic function of the Reticulo histiocytic system, the morphological phenomena associated with maturation and differentiation and the ultra structure of the cells of different developmental lines are also presented.

X-ray diffraction studies, microscopic anatomy, the *in vitro* cultivation and transplantation experiments with bone and cartilage and electron microscopic studies and histochemical properties of the skin, integument and pigment cells are summarized in the next two chapters.

Some of the contemporary concepts about the sites of antibody formation and the cells involved in the process are reviewed by McMaster. The author makes a strong plea for more detailed and critical investigations on haematological cytology and on the genesis and life-cycles of the various cells concerned with antibody formation.

The morphology, physiology and biochemistry of the cancer cells are given in the last two chapters. The problem of glycolysis and respiration are described at length because of its special significance in the metabolism of cancer cells. Several theories put forward in recent years to explain carcinogenesis and which are based on biochemical mechanisms are also briefly outlined.

These volumes can be unreservedly recommended as indispensable reference work for

students and research workers in cell physiology and biochemistry.

C. S. V.

P. S. S.

#### Advances in Applied Microbiology, Vol. III.

Edited by W. W. Umbreit. (Academic Press, New York and London; India: Asia Pub. House, Bombay-1), 1961. Pp. xi + 421. Price \$13.00.

While it is true that during the last few years several volumes designed to review the "Progress" or "Developments" in Industrial Microbiology have appeared, there still exists a need for authoritative annual volumes devoted to publishing "reasoned thoughtful essays on the contemporary problems of this field". The third volume in the series under review takes stock of several important problems in Applied Microbiology as represented by the "Preservation of Bacteria by Hyophilization, Nature and Economic Significance of *Sphaerotilus*, Large-scale Use of Animal Cell Cultures, Devices and Procedures for Protection against Infection in the Microbiological Laboratory, Oxidation of Aromatic Compounds by Bacteria, Screening for and Biological Characterization of Anti-tumor Agents using Micro-organisms, the Classification of Actinomycetes in relation to their Antibiotic Activity, the Metabolism of Cardiac Lactones by Micro-organisms, Intermediary Metabolism and Antibiotic Synthesis, and Methods for the Determination of Organic Acids". All the contributors, every one, an expert in his field, have fulfilled ably the task of sifting "that which is fundamental and enduring from that which is significant and doubtful", and to present a book which is a valuable and welcome addition to the literature. It will be found very useful by all those interested in the subject.

J. V. BHAT.

#### Instrumental Methods for the Analysis of Food

Additives. Edited by W. H. Butz and H. J. Noebels. (Interscience Publishers, New York), 1961. Pp. viii + 238. Price \$11.00.

This volume gives an account of the proceedings of a symposium and workshop on "Instrumental methods for the analysis of food additives" held at the Kellogg Centre for continuing education, Michigan State University, between March 24 to 26, 1960. The symposium was sponsored by the Food Technology Program of Michigan State University, the National Canners Association, the American Meat Institute Foundation and the Packing Institute.

The symposium deals with a problem of great importance in food processing. During recent years several countries have promulgated acts, restricting the number and quantity of additives which can be safely added to processed foods without endangering the health of the consumer. There is an urgent need for evolving simple and accurate methods for determining the quantities of additives added to processed foods. The different categories of substances, which can be classified as additives, include synthetic colours, preservatives, anti-oxidants, etc. Insecticides and pesticides come indirectly under this category as foods treated with pesticides or insecticides contain residual amounts of these chemicals which are harmful to the body. As stated by the editors in the preface, "The prime purpose of this symposium was an exchange of information between the people who had been working on both additive and pesticide residue problems for a number of years and the food technologist facing problems of low level analyses for the first time". A number of Government, University and industry research groups actively working on the analysis of food additives have participated in the symposium. The subject-matter covered includes the following; (1) food additives amendment act, (2) extraction techniques for food additives, (3) colorimetric procedures for the determination of food additives, (4) the use of ultra-violet and infrared spectrophotometry in the determination of pesticides, (5) use of isotope dilution techniques in the analysis of food additives and (6) application of gas chromatography in pesticide analysis. This volume also contains three chapters dealing with the following important topics: (1) Equipping the Residue Laboratory, (2) Analysis of direct food additives and (3) Analysis of food additives resulting from contact with containers or equipment.

This publication contains a fund of valuable information and should prove highly useful to research workers in the field of food additives and pesticides and to public analysts who are faced with the problem of determining food additives in processed foods.

M. SWAMINATHAN.

**Introduction to Animal Virology.** By A. P. Waterson. (Cambridge at the University Press), 1961. Pp. 96. Price 22 sh. 6 d.

The subject of Virology is rapidly developing as most of the Bacterial Diseases are either effectively controlled or in a stage of eradication. Extensive studies in recent years have

produced a change in the concept of Viruses regarded as 'Abnormal transmissible cell components' rather than 'very small microbes'. Better techniques in isolation of viral agent, its identification and diagnosis of disease have been evolved.

Most of the essential topics of interest are briefly described. Biological, Physical, Chemical Status, the method of growth, multiplication and purification of viruses and the several factors involved in the causation of diseases are illustrated with suitable examples. The Potentialities of Electron Microscopy, Tissue Culture Techniques, Interference Phenomenon, Studies on Genetics and Tumour Viruses have been briefly described.

A chapter dealing with Classification of Viruses and the Role of Complement Fixation, Haemagglutination Inhibition and Neutralisation Tests could have been included.

However, a book of this type fulfils the want of Medical, Biological and Veterinary students.

D. P. N. MURTHY.

**Scientific Research in British Universities, 1960-61.** (Her Majesty's Stationery Office, London), 1961. Pp. 513. Price £ 1-12-0.

This compendious volume provides useful and exact information on scientific research in progress, during the academic session 1960-61, in the various scientific departments and centres of research connected with British Universities. There are 23 universities in Great Britain many of which besides having their own departments of science have science and technical colleges affiliated to them. Many are also associated with a number of medical colleges, schools and institutes. London University alone has 12 colleges which are primarily devoted to science teaching and research, and 30 colleges, schools and institutes which are primarily devoted to medical research. In all there are seventy-six such research centres connected with British Universities and the total number of scientists working at these centres is well near 10,000. The purpose of this volume whose publication is sponsored by the Department of Scientific and Industrial Research under an arrangement with the British Council, is to describe the nature of scientific research and teaching that is currently going on in all these centres.

The entries in the volume indicate the scope of the research done at the various departments and colleges and the names of the scientists engaged either individually or as a team in the investigations concerned. In making the entries

the universities are taken in the alphabetical order, and under each university (or college) the departments are serially numbered, and under each department the names of the scientific and supervising staff are given with the problem of research briefly indicated against each. From the Name Index and Subject Index which have been carefully prepared and given at the end of the volume, it will be easy to find out what problem a particular scientist is engaged in and where, or by whom and where a particular problem of research is being carried on during the year.

The importance of this publication needs no emphasis especially in the context of the Commonwealth Scholarship and Fellowship Plan now on, one of the aims of which is to provide facilities for research in British Universities in well-defined fields to young scientists of developing Commonwealth Countries.

A. S. G.

#### A Synopsis of the Birds of India and Pakistan.

By Sidney Dillon Ripley II. (The Bombay Natural History Society, Bombay-6), 1961. Pp. xxxvi + 702. Price Rs. 25-00.

The volume is a well-prepared up-to-date compilation of the Avifauna of the Indian region. It lists more than 2,000 species of birds from India, Pakistan, Nepal, Sikkim, Bhutan and Ceylon indicating their systematics and distribution; however, taxonomic descriptions of species are not given. The book would prove useful to Ornithologists to the extent that the nomenclature adopted has been standardized and latest views regarding classification have been incorporated. The absence of illustrations except for two sets of maps is conspicuous in a work of this type. The political divisions shown on the map in the first plate could have been made up-to-date by marking the reorganized States.

In conclusion, it is apt that the Bombay Natural History Society has brought to light this useful book whose price, though it touches the pocket of the individual bird student, would not do so of an Institution.

B. A. G.

**How to Know the Ferns—(A Guide to the names, haunts and habits of our common ferns).** By F. T. Parsons. (Dover Publications, Inc., 180, Varick Street, New York-14), 1961. Pp. xiv + 210. Price \$ 1.25.

Ferns, the most highly developed of all cryptogams, have been the subject of intensive

study by botanists. They are astonishing in their variety, in their varied habits of growth, and in their beauty.

This popular book on ferns by Miss Parsons, first published in 1899, and accepted since then to be the most interesting introduction to the world of North American ferns has now come out as a Dover Publication.

After an introduction on ferns and their life cycle, the book describes 57 important ferns, with botanical descriptions, range, environment and full woodlore. For the purpose of identification the ferns described are arranged in six groups according to their manner of fruiting. The great attraction of the book is in the more than 100 illustrations of which 42 are full page line drawings which will help beginners in identifying the different types of ferns.

Written in simple, yet scientifically accurate, style the book will appeal even to lay men interested in ferns.

#### Books Received

From: Cambridge University Press, Bentley House, London N.W. 1:

*Cartesian Tensors.* By H. Jeffreys, 1961. Pp. vi + 92. Price 8 sh. 6 d.

*The Twelfth Symposium of the Society for General Microbiology*, No. 12—Microbial Classification. Edited by G. C. Ainsworth and P. H. A. Sneath, 1962. Pp. ix + 483. Price 50 sh.

*Discovery Reports* (Vol. XXIII)—Movements of Fin and Blue Whales within the Antarctic Zone. By S. C. Brown, 1962. Pp. 1-54. Price 30 sh.

*Principia Mathematica.* By A. N. Whitehead and B. Russell, 1962. Pp. xvi + 410. Price 17 sh. 6 d.

From: Dover Publications, Inc., 180 Varick Street, New York-14:

*Fundamental Formulas on Physics.* Edited by D. H. Menzel, Vol. I: Pp. 364. Price \$ 2.00; Vol. II: Pp. 364-741. Price \$ 2.00.

*Theory of Functions as Applied to Engineering Problems.* Edited by R. Rothe, F. Ollendorff and K. Pohlhausen, 1961. Pp. x + 189. Price \$ 1.35.

*Theory and Applications of Finite Groups.* By G. A. Miller, H. F. Blichfeldt and L. E. Dickson, 1961. Pp. xvii + 390. Price \$ 2.00.

*Tables of Indefinite Integrals.* By G. Petit Bois, 1961. Pp. xiv + 151. Price \$ 1.65.

*Introduction to Elliptic Functions with Applications.* By F. Bowman, 1961. Pp. 115. Price \$ 1.25.

*Summation of Series Collected.* By L. B. W. Jolley, 1961. Pp. xii + 251. Price \$ 2.00.

- The Theory of Determinants, Matrices and Invariants.* By H. W. Turnbull, 1961. Pp. xviii + 374. Price \$ 2.00.
- Lectures on the Calculus of Variations.* By Oskar Bolza. Pp. xi + 271. Price \$ 1.65.
- The Chemistry of Uranium, the Element, its Binary and Related Compounds.* By J. J. Katz and E. Robinowitch, Pp. xxi + 609. Price \$ 2.95.
- From: John Wiley and Sons, Inc., 440 Park Avenue South, New York-16 :
- Scientific Foundations of Vacuum Technique.* (2nd Edition). By S. Dushman and J. M. Lafferty, 1962. Pp. xviii + 806. Price \$ 19.50.
- Discrete Variable Methods in Ordinary Differential Equations.* By P. Henrici, 1962. Pp. xi + 407. Price \$ 11.50.
- Thermoelectricity an Introduction to the Principles.* By D. K. C. MacDonald, 1962. Pp. viii + 133. Price \$ 6.50.
- Elements of Infra-red Technology—Generation Transmission and Detection.* By P. W. Kruse, L. D. McGlauchlin and R. B. McQuistan, 1962. Pp. xxi + 448. Price \$ 10.75.
- Methods of Biochemical Analysis* (Vol. 9). Edited by David Glick, 1962. Pp. ix + 452.
- Experimental Thermochemistry* (Vol. 2). Edited by H. A. Skinner, 1962. Pp. xix + 457. Price \$ 14.50.
- Introduction to Immunochemical Specificity.* By W. C. Boyd, 1962. Pp. viii + 158. Price \$ 8.00.
- Researches on Meteorites.* Edited by C. B. Moore, 1962. Pp. xii + 227. Price \$ 7.00.
- From: Pergamon Press, Headington Hill, Hall, Oxford :
- Atomic-Absorption Spectrophotometry.* By W. T. Elwell and J. A. F. Gidley, 1961. Pp. vii + 102. Price 30 sh.
- Introduction to Calculus.* By K. Kuratowski, 1961. Pp. 315. Price 35 sh.
- Introduction to Set Theory and Topology.* By K. Kuratowski, 1961. Pp. 275. Price 45 sh.
- Non-Euclidean Geometry.* By S. Kulczycki, 1961. Pp. 208. Price 70 sh.
- Complex Variable and Some of Their Applications.* By B. A. Fuchs and V. I. Levin, Pp. x + 286. Price 50 sh.
- Proceedings of the International Symposium on Linear Spaces.* 1961. Pp. xi + 452. Price £ 5.0.0.

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## SCIENCE NOTES AND NEWS

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### Award of Research Degree

Andhra University has awarded the D.Sc. Degree in Physics to Shri K. V. Kameswara Rao, for his thesis entitled "Spectroscopic Investigations on some Di-Substituted Benzenes".

### Symposium on Water Evaporation Control

A Symposium on Water Evaporation Control organized jointly by the UNESCO South Asia Science Co-operation Office and the Council of Scientific and Industrial Research, will be held at the National Chemical Laboratory, Poona (India), on December 17-20, 1962.

The scope of the symposium will be: (1) Physics and Chemistry of Monolayers on Water Surfaces: Resistance to evaporation; Spreading behaviour, phase transformation in the solid and related measurements; Physical properties of monolayers, such as compressibility, 2-d-viscosity, surface potential, collapse pressures, etc. (2) Field and semi-field experiments: Formulation; Evaporation control; Application and maintenance of monolayers. (3) Special lectures by the experts.

The participants at the symposium will include (i) Unesco-sponsored delegates from South Asia, (ii) International Experts, (iii) Specialists from other countries interested in the problem, and (iv) participants coming on their own or their institutions' account.

Presentation time for each paper will be about 15 minutes followed by discussion. The experts will also deliver a few special lectures of about an hour's duration each. The working language of the symposium will be English.

Participants are requested to submit the summaries of their papers to Dr. A. B. Biswas of the National Chemical Laboratory, Poona-8, before the end of July, and the full manuscripts at latest by the middle of October 1962.

Further information can be obtained from: Dr. J. Swarbrick, Director, UNESCO South Asia Science Co-operation Office, 100, Sunder Nagar, New Delhi (India).

### IAEA Symposium on Radiation Damage

The International Symposium on Radiation Damage in Solids and Reactor Materials,

organized by the International Atomic Energy Agency (IAEA) was held in Venice from May 7-11, 1962.

Experts from 24 countries and one international organization discussed a large number of subjects ranging from the fundamentals of the atomic structure of solids to the practical problems of their direct applicability to the development of nuclear power reactors.

The effect of nuclear radiation is to eject individual atoms from their normal position in solids and the cumulative effect of a large number of submicroscopic individual defects produces a significant modification of the physical properties of irradiated materials. The symposium paid particular attention to experimental studies of irradiation effects on the properties of simple metals in which effects are easiest to interpret.

Although appreciable effects in metals are produced by relatively short-time irradiation in reactors, the effects are still more apparent in other materials, particularly in semiconductors. A special session of the symposium was, therefore, devoted to the study of semiconductors.

The symposium reviewed the state of current knowledge on radiation effects in materials used for the construction of reactors, including nuclear fuels in the form of metallic uranium and of ceramic compounds of uranium, structural materials and moderators, such as graphite and beryllium.

The following scientists acted as chairmen of the various scientific sessions or as leaders of panel discussions: Prof. A. Seeger (Germany), Dr. H. G. Van Bueren (Netherlands), Prof. S. V. Starodubtsov (USSR), Prof. E. W. J. Mitchel (U.K.), Dr. E. Nagy (Hungary), Dr. W. Kosiba, (Euratom), Prof. P. Baruch (France), Prof. E. Andronikashvilli (USSR), and Dr. L. Giuletto (Italy).

#### International Symposium on Locusts (Paris, April, 1962)

An international symposium on the Physiology, Behaviour and Ecology of Locusts in Relation to Phase, organised by the Centre National de la Recherches Scientifique in the Ministry of Education, Republic of France, was held in Paris from 9 to 13 April 1962. The Symposium was presided over by Sir Boris Uvarov, the well-known authority on locusts and the originator of the phase theory. A total of 39 scientists (20 participants and 19 observers) drawn from eleven countries, participated.

The work of the Symposium was divided into four sections: Physiology, Behaviour, Ecology and

General. The section on Ecology was presided over by Dr. M. L. Roonwal, Director, Zoological Survey of India. A wide variety of subjects were covered at the Symposium. These included the role of hormones in phase production; Phase and non-phase polymorphism in the Desert Locust; behaviour of hoppers; and flight activity in relation to meteorological factors.

The proceedings of the symposium, complete with the papers and the discussions, are expected to be published by the C.N.R.S.

#### Summer School in Solid State Physics

Under the joint auspices of the Physical Research Committee of the Council of Scientific and Industrial Research, New Delhi, and the University Grants Commission, a Summer School in Solid State Physics was held at Kodaikanal, South India, from 21st May to 8th June 1962. The School was attended by a large number of research workers from the various universities and research institutes of the country. Besides a series of lectures on different aspects of the subject there were also seminar talks and discussions on problems connected with the latest developments in theory and technique.

#### Radio Emission from Solar Flares

As a result of extensive studies made in the International Geophysical Year, it has now been well established that during a solar flare the Sun emits bursts of X-rays, protons and shock waves. The X-rays reach the earth within a few minutes of the initial explosion on the Sun, and produce sudden ionospheric disturbances accompanied by radio fade-outs. About fifteen minutes later a group of protons of high velocity arrive, producing observable increases in cosmic ray activity. This is followed by a group of slow protons reaching after about an hour and bombarding the polar regions.

In the case of large flares it is observed that in addition to the above there arises another disturbance moving outwards with speeds of the order of 1000 km./sec. This is identified as the shock wave which arrives about 30-40 hours after the first event in the Sun, and is responsible for the production of auroras and magnetic storms at the earth. It is believed that the energy involved in the release of these disturbances comes from the destruction of the magnetic field of sun-spots associated with the flare.

#### Australian Work in Seismology during the IGY

At a Symposium held in Adelaide late in February 1962, to discuss the results of



Australian work for the IGY, many papers of interest were presented. Professor K. E. Bullen, of the University of Sydney, narrating the contribution in the field of seismology, listed among others the following chief advances: (1) The first determination of the thickness and layering of the crust anywhere in Australia; this was made possible by the data from Maralinga atomic tests. (2) The first proof that Antarctica is seismically the quietest land mass in the world, Australia taking the second place. (3) The more precise determination of the Earth's internal structure made possible by pre-known nuclear test explosions. (4) The confirmation from records of the great Chilean earthquake of 1960 that major earthquakes cause the earth to resonate as a whole with its own natural elastic frequencies. (5) More accurate data on the figure of the earth obtained from studies of satellite orbits.—(*Australian Science Newsletter*.)

#### Science Progress

The current issue of the *Science Progress*, April 1962, contains the following feature articles besides Reports on recent advances in science, Reviews, etc. The "Lusitanian Element" in the British Fauna, by G. B. Corbett; Tectonics and Palaeogeography in Southern England, by T. Neville George; and Mechanisms of Toxicity of Agricultural Fungicides, by E. Somers.

#### International Satellite "Ariel"

The International satellite Ariel, which was launched from Cape Canaveral, Florida, U.S.A., has now been in orbit for 33 days, and yesterday (May 29) the Royal Society in London gave details of the satisfactory performance of the British scientific instruments carried by the satellite. (The Royal Society co-ordinated the experiments which are being carried out.)

The satellite is orbiting the earth once every 101 minutes at heights of between 240 and 760 miles. Ariel spins, as planned, at one revolution per second, and radio signals showed that the solar-cell paddles, which re-charge the batteries, and the instrument booms have all been deployed correctly.

The temperature of the satellite has been little above the planned level but well within tolerance, even though Ariel is now orbiting mostly in direct sunlight.

All the experimental equipment is working correctly except the solar ultra-violet detector, and it is not yet certain whether any data will be obtained from the latter.

Telemetry signals from the satellite are being recorded at 15 stations around the world.—(*British Information Service*.)

#### Lady Tata Memorial Trust Scholarships and Grants for the Year 1962-63

The Trustees of the Lady Tata Memorial Trust announce on the death anniversary of Lady Meherbai Dorabji Tata, 18th June 1962, the awards of scholarships and grants for the year 1962-63.

International Awards [of varying amounts (totalling £6,000)] for research in diseases of the blood with special reference to Leukæmias are made to: Dr. L. Chieco-Bianchi (Italy), Dr. H. J. Woodliff (Australia), Dr. J. L. Amiel (France), Dr. B. Lagerlof (Sweden), Dr. R. L. Blakley (Australia), Dr. S. Itzhaki (England), and Dr. B. Pedersen (Denmark).

Indian Scholarships (of Rs. 250 per month each for one year) for scientific investigations having a bearing on the alleviation of human suffering from disease are awarded to: Mr. S. K. Sankarappa (Madras), Mr. V. N. Gogte (Bombay), Dr. Brij Mohan Singh Bedi (New Delhi), Dr. V. N. Ingle (New Delhi), Miss P. Malathi (Bangalore), Dr. (Miss) R. R. Malva (Bombay) and Mr. S. S. Ranade (Bombay).

#### A New Amino-Acid Isolated from Seeds of *Reseda odorata* L.

During investigations of the contents of free amino-acids in certain plants containing isothiocyanate-producing glucosides, attention was directed to species of the family *Resedaceæ*. When a seed extract of the popular garden flower mignonette (*Reseda odorata* L.) was subjected to paper chromatographic amino-acid analysis, a compound, exhibiting a greyish-blue colour with ninhydrin, was noticed next to a strong spot of glutamic acid on two-dimensional chromatograms. The same compound possessed the notable property of exhibiting a brilliant blue or violet-blue fluorescent on exposure of the paper chromatograms to light of the wavelengths 254 m $\mu$  and 350 m $\mu$  respectively. Paper electrophoresis indicated that the unknown substance was a strongly acid amino-acid.

Efforts directed towards isolation of the new amino-acid from the free amino-acid fraction of seeds of *Reseda odorata* L. were successful. The new amino-acid was demonstrated to be 3-(3-carboxy-4-hydroxy-phenyl)-L-alanine (*m*-carboxy-L-tyrosine).

The isolation was accomplished by means of strongly acid and weakly basic ion-exchange resins and the final purification by recrystallization from water. Elemental analysis, ultra-violet and infra-red absorption spectra, protolytic properties and other data suggested 3-(3-carboxy-4-hydroxy-phenyl)-alanine as a likely structure for the isolate. Authentic material with L-configuration was synthesised by a series of steps departing from 3-nitro-L-tyrosine and proceeding via 3-(3-cyano-4-hydroxy-phenyl)-L-alanine. On comparison, the synthetic specimen proved identical with the natural amino-acid. The latter represents the third example of *m*-carboxy-substituted aromatic amino-acids encountered in higher plants.—(*Acta Chemica Scand.*, 1962, 16, 142.)

#### Non-Palaeontological Method of Correlation of Rocks of Tertiary Age: Heavy Elements in Bone Fragments

According to R. S. Houston of the Department of Geology, University of Wyoming, U.S.A., the evaluation of heavy elements content in geological specimens of bone fragments may possibly be used as an aid in correlating non-fossiliferous rock of Tertiary age.

Geologists find that all too often bone fragments may be found in Tertiary rocks that cannot be positively identified or are too poorly preserved for identification, and yet these fragments may be the only clue to the age units in a given area. Field geologists know that bones of different age have a distinctly different appearance in hand specimen and they feel that some compositional difference may be the cause. It was therefore considered worth while to determine the composition of a number of well-dated bone fragments to see if there was any systematic variation in chemical composition with age.

Forty-one bone specimens were studied by X-ray emission spectrography method, for quantitative examination of the heavier elements Fe, Sb, Ba, Sr and As. The method is not suitable for lighter elements because elements lighter than titanium cannot be detected

with an air path. The method consisted in measuring the peak intensity for K-alpha radiation using tungsten target as proportional detector.

Iron was the only element to show systematic variation with age, although arsenic appears to be less abundant in older bone fragments. As a test to determine whether or not the presence of different species of animals in rocks of different age may be a contributory factor in the variations of iron shown, eight samples of horse bone fragments of different geological ages were also studied for their iron content. In both cases an increase in iron content through time was obvious. This systematic increase in iron content suggests that some element in bones, possibly magnesium, may be gradually replaced by iron from the matrix of the rock in which the bone is embedded. Where the matrix contains very little iron, as in the case of the Oligocene rocks studied, the replacement does not occur.

The method suggests that bone fragments from Wyoming that are exceptionally rich in iron are more likely to be early Tertiary in age which may be useful in solving some correlation problems of a general nature.—(*Contributions to Geology*, Vol. 1, No. 1, January 1962, University of Wyoming Laramie, Wyoming.)

#### Research Careers in Defence Research and Development Organisation

We have received a copy of the above-entitled brochure (16 pages) published by the R. & D. Organisation, Ministry of Defence, 'G'-Block, Hastings Road, New Delhi-11.

This brochure gives the career prospects available to the First or Second Class M.Sc.'s, Graduates with First or Second Class Honours or equivalent in Technology and Engineering and to the post-graduate research workers, scientists and engineers.

This brochure contains a few selected examples of research topics undertaken in the R. & D. O. Laboratories, the particulars of grades, pay scales and other conditions of service.

# TRADITIONAL RICE CULTIVATION PRACTICES

## Should there be a Reappraisal ?

H. D. JORDAN

Director, West African Rice Research Station, Rokupr, Sierra Leone

AFRICA is traditionally the dark continent but may it not perhaps put forth some light? Has not the evolution of rice cultivation there followed similar lines to that of rice cultivation in the East thousands of years earlier? In Africa the wild species *Oryza breviligulata* and *O. stapfii* are plants of wet places. The distinction between the two species is not clear cut and the ecological and morphological differences which are apparent may be the extremes of a range of types. From this wild population we believe that the cultivated *O. glaberrima* has arisen—in fact the distinction between some forms of *O. glaberrima* and *O. stapfii* is not altogether clear. *O. glaberrima* in cultivation occurs in two main forms—that of a deep-water floating rice and that of an upland rice. The floating types are confined to comparatively few places while the upland types extend over a wide area. There do not appear to be any types of *O. glaberrima* which are normal swamp rices. The first question we should ask is therefore:

May not the cultivation in the East of *O. sativa* have arisen as upland cultivation from the original wild wetland species?

At this stage in Africa *O. sativa* was introduced as an upland rice and the story as it progresses is with this species. As pressure on the upland increased, rice cultivation extended on to land which seasonally became wet and it was found that some plants withstood these wetter conditions. With further pressure on the land, cultivation was carried out in valley bottoms on true wetland. The old practice of direct broadcasting of seed was at first used but it was found difficult to cover the seed in the wetter soil and other methods had to be evolved. It is not clear whether broadcasting of pregerminated seed on the surface of the wet soil became general, to be replaced later by transplanting, or whether both methods developed side by side. In any case, transplanting soon became the usual method and the sowing of pregerminated seed now only lingers in a few places. Transplanting was evolved because of the damage to directly sown seed

by water movement—in fact the first transplanting carried out was with seedlings which had been washed out of a farm by heavy flood, were found caught up on the root of a tree, and were pushed back into place by the farmer. The soil in these wetlands being permanently soft, this method spread swiftly over the whole area—the seedlings being safely raised on the uplands away from the floods. The second question is therefore: Did not possibly a similar sequence of causes and events obtain in Asia in the dim and distant past?

Here we must leave Africa, as at the present time no further steps have been taken, but we can examine in Asia what we know to have happened and conjecture the probable course that rice cultivation may have followed.

Over the centuries pressures on the land increased, and with the rise of ancient civilizations attention was turned to increasing the areas on which swamp rice—now the main form of rice and the staple food of the people—could be grown. Elaborate irrigation works were carried out and land which was formerly too dry to mature a crop became available. Is it not probable that the transplanting method, having by now become so traditional, was carried to this new land although the need for it on account of water movement had vanished? And that the land being firm it was necessary to evolve the new technique of puddling in order to prepare it for transplanting?

On this irrigated upland weeds were more of a problem than in the natural valley bottoms and swamps, but it was found that if the water used to irrigate and soften the land was held on the land with the growing crop the weed problem was much reduced. And that the pre-flooding itself caused weed seeds to germinate and they could be removed before the rice was planted. Is not this the reason why transplanting as a method persisted, and the holding of water on the rice land became a general practice? Is not rice in fact a crop that will tolerate standing water rather than one which needs it? And have comparisons of yield between transplanting and direct seeding made in

the past been strictly valid, i.e., may not differences found have been due to other factors such as greater uniformity of spacing?

Having asked ourselves these questions, it becomes logical to ask two more. Now that effective weedicides appear to be bringing the weed problem under control, is it still necessary to hold standing water on rice land to its present extent, and are in fact transplanting and puddling still essential? There will of course be many conditions where they are for various reasons, but are they essential in all conditions where they are now used? Finally, to generalize: Were not the traditional cultural practices closely linked into a uniform

method, and should not changes that have been made in some of these practices be followed by a general-reappraisal of the others now that the balance of the method has been upset?

I do not pretend to know the answers to these questions but have long wondered if we should not try to answer them. And I know that some at least are in the minds of other rice workers. Certainly recent work with varieties of high fertilizer response has shown that we must re-examine all we know about fertilizer application and plant density. I think the time has come when we should all make a critical reappraisal of the whole range of traditional cultural practices.

## EMBRYOLOGY AND SYSTEMATIC POSITION OF *PENTAPHRAGMA HORSFIELDII* (MIQ.) AIRY SHAW

R. N. KAPIL AND M. R. VIJAYARAGHAVAN

Department of Botany, University of Delhi, Delhi-6

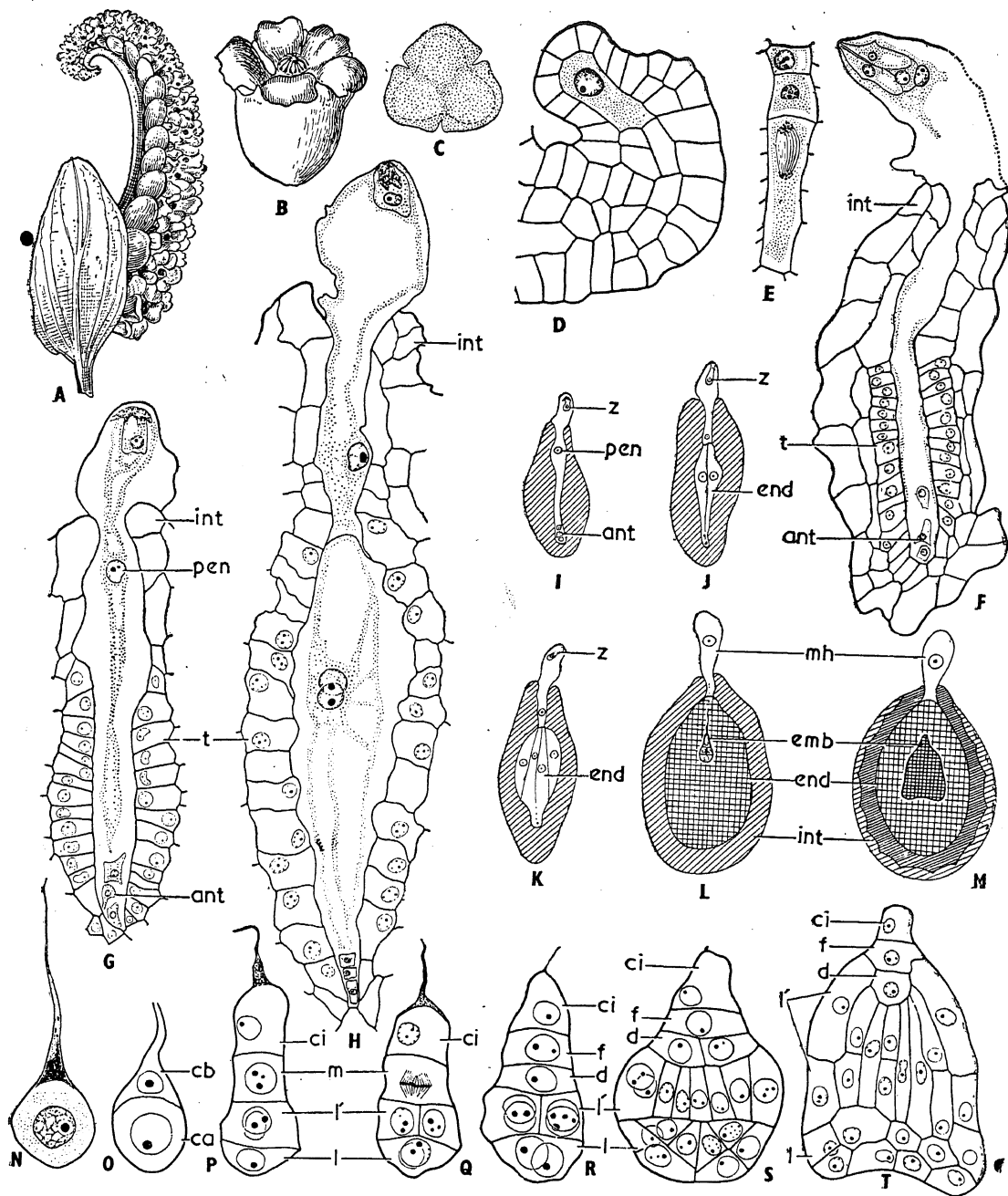
THE genus *Pentaphragma* came into prominence recently when Airy Shaw<sup>1,2</sup> sought to remove it from the Campanulaceæ and raised it to the status of a new family Pentaphragmataceæ. According to him its habit and foliage suggest certain Begoniaceæ, Rubiaceæ (*Argostemma*), and Gesneriaceæ (*Epithema*); the succulence of the stem and leaves recalls the Cucurbitaceæ; the scorpioidally cymose inflorescence is similar to that of some Hydrophyllaceæ and Boraginaceæ; and the indumentum of branched, multicellular hairs resembles the Solanaceæ. He remarked: "Almost every author who has dealt with *Pentaphragma* has admitted its highly anomalous position in the Campanulaceæ, and it is therefore surprising that it has not been removed earlier."

Bentham and Hooker,<sup>3</sup> and Engler and Prantl<sup>4</sup> included *Pentaphragma* in the Campanulaceæ. Hallier (quoted in Airy Shaw<sup>1</sup>) retained this genus in the Campanulaceæ, but admitted that it showed certain resemblances in its inflorescence with the Boraginaceæ, Convolvulaceæ (*Jacquemontia*) and Loasaceæ (*Kissenia*). According to Metcalfe (cited in Airy Shaw<sup>1</sup>) there is nothing about its anatomy "which is inconsistent with the suggestion that the plant may belong to the Begoniaceæ". However, Metcalfe and Chalk<sup>5</sup> have themselves included it as an anomalous genus in the

Campanulaceæ. In view of the divergent opinions of taxonomists, it was considered worthwhile to investigate the embryology of *P. horsfieldii*, material of which was very kindly supplied to us by Mr. K. Jong and Dr. A. N. Rao of the Universities of Malaya and Singapore.

The inflorescence is a scorpioid cyme with numerous flowers arranged in acropetal succession (Fig. A). The flowers (Fig. B) are small, sessile, bisexual and actinomorphic (excepting the calyx). The ovary is bicarpellary, bilocular and inferior, and contains numerous anatropous ovules arranged on axile placenta. The wall of the anther is made up of five layers—the epidermis, the fibrous endothecium, two middle layers and the tapetum whose cells become binucleate. The pollen grains are tri-colporate (Fig. C) with a thick exine.

The ovule is unitegmina1 and tenuinucellar. A single hypodermal archesporial initial differentiates and directly functions as the megaspore mother cell (Fig. D). It is surrounded by the evanescent nucellar epidermis. A linear tetrad is formed (Fig. E) and the chalazal megaspore functions to give rise to an eight-nucleate gametophyte of the Polygonum type. The micropylar portion of the embryo sac (Fig. F) invariably comes out of the integument at the four-nucleate stage. The antipodal cells degenerate after fertilization but



FIGS. A-T. (ant, antipodal cell; emb, embryo; end, endosperm; int, integument; mh, micropylar haustorium; pen, primary endosperm nucleus; t, endothelium; z, zygote).

Fig. A. Scorpioid cymose inflorescence. Fig. B. Single flower. Fig. C. Palynogram. Fig. D. Megaspore mother cell. Fig. E. Formation of linear megaspore tetrad. Fig. F. Mature embryo sac with extramicropylar egg apparatus. Fig. G. Embryo sac showing zygote and primary endosperm nucleus; the antipodal cells are still healthy. Fig. H. Three-celled endosperm. Figs. I-M. Stages in the development of endosperm (diagrammatic). Figs. N-T. Embryogeny. Fig. A,  $\times 1.5$ ; Fig. B,  $\times 6$ ; Figs. C-E, N-S,  $\times 744$ ; Figs. F-H,  $\times 400$ ; Fig. T,  $\times 460$ .

may be seen as darkly stained masses during the first few divisions of the endosperm.

The endosperm is Cellular. The first division of the primary endosperm nucleus (Fig. G) is followed by a transverse wall resulting in a small micropylar and a large chalazal chamber (Fig. H). The micropylar chamber remains undivided and forms a haustorium with a hypertrophied nucleus. Vertical divisions in the chalazal chamber result in a four-celled endosperm followed by further divisions to give rise to the endosperm proper (Figs. I-M). We have not found any chalazal haustorium.

The zygote elongates considerably and pushes its way into the endosperm. The first two divisions are transverse resulting in a four-celled linear proembryo. The tiers *l* and *l'* divide by vertical walls to form the octant, while *m* divides transversely to produce the cells *d* and *f*. As regards their further fate, *l* gives rise to the cotyledons and shoot apex; *l'* to the hypocotyl and to the periblem and plerome of the root; and *d* to the root tip. The remaining cells *f* and *ci* produce the suspensor. The development of the embryo thus conforms to the Solanad type (Figs. N-T).

At the time of fertilization the single integument comprises the epidermis, a middle layer and endothelium. However, only the epidermis persists in the mature seed. Its cells become thickened in the lower portion.

Although *Pentaphragma* shows some resemblances with the Begoniaceae in its anatomy (see Airy Shaw<sup>1,2</sup>), members of the latter differ radically in other respects. The Begoniaceae are characterized by monœcious and unisexual flowers with 2 or 5 valvate sepals; 2-5 imbricate petals (sometimes absent); a bi- or tricarpeillary ovary which is usually 2 or 3 (rarely 4-6) chambered; 2-5 connate styles with twisted stigma; winged fruits; and seeds with scanty endosperm. The ovule is bitegminal and crassinucellar; the antipodal cells degenerate before the organization of the embryo sac; the endosperm is Nuclear; and the embryogeny

follows the Onagrad type. Similarly the Boraginaceae differ in having a superior ovary; multinucleate tapetal cells; crassinucellate ovules; Polygonum or Allium type of embryo sac with ephemeral antipodal cells; Nuclear, Cellular or Helobial endosperm and Chenopodiad type of embryogeny. Hence any close relationship between *Pentaphragma* and these two families is out of question.

On the other hand, the Campanulaceae resemble *Pentaphragma* in having bisexual, zygomorphic flowers; secretory type of anther tapetum with binucleate cells; inferior, bicarpellary, bilocular ovary; numerous anatropous, unitegminal and tenuinucellar ovules with endothelium restricted to the chalazal portion of the embryo sac; Polygonum type of embryo sac; antipodal cells degenerating after fertilization; Cellular endosperm; Solanad type of embryogeny; and a seed coat formed from the outer epidermis of the integument. However, *Pentaphragma* shows a few distinctive features like the extramicropylar embryo sac, uninucleate micropylar haustorium, and a short suspensor of the embryo.

It may be concluded that *Pentaphragma*, although somewhat aberrant, correctly belongs to the Campanulaceae.

It gives us great pleasure to thank Professor P. Maheshwari for his guidance and suggestions, and to Mr. N. N. Bhandari for useful discussions. Appreciation is also expressed to the National Institute of Sciences of India and the Government of India, for the award of a Senior and a Junior Research Fellowship to us. Thanks are also due to Mr. D. M. Sonak for drawing some illustrations.

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## MINOR CONSTITUENTS OF INDIAN SEA-WATER

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THE quantities of nine minor constituents in Indian sea-water (Bhavnagar coast) were reported in an earlier note.<sup>1</sup> The present communication deals with the estimation of fourteen minor elements, including the nine reported earlier, and the analytical procedures followed.

## EXPERIMENTAL

Samples of sea-water were collected near the Bhavnagar port during high tides in the months of March to April. The density of sea-water was between 3.0°–3.3° Be'. The brine was filtered and stored in chemically resistant glass vessels. The data obtained on analysis of this sea-water and the corresponding data for ocean waters elsewhere are included in Table I.

in presence of mannitol. The method as modified by Foote<sup>3</sup> for sea-water was adopted.

4. *Fluorine*.—Fluorine was determined colorimetrically using zirconium alizarin sulphonate as indicator.<sup>4</sup> The colour developed by the indicator was measured colorimetrically in Nessler tubes and compared with those of the standard solutions in the range from 0.10 to 1.20 milligram fluorine per litre.

5. *Rubidium*.—Since Rubidium content in sea-water is very small, fifteen litres were concentrated to a volume of 1.5 litre. The salts separated during evaporation were washed with alcohol and from the collected filtrate and washings rubidium and potassium were

TABLE I  
*Minor constituents of Indian sea-water*

No.	Constituent of sea-water	Indian sea-water (Bhavnagar coast)	Known values for other oceans	Reference
			(Microgram per litre)	
1	Bromine	43,600	64,600	Barnes (1951) <sup>14</sup>
2	Strontium	11,800	9,000–11,000	Smales (1951) <sup>15</sup>
			8,150	Odum (1951) <sup>14</sup>
3	Boron	2,200	1,530–5,100	Igelsrud <i>et al.</i> (1938) <sup>14</sup>
4	Fluorine	800	1,400	Thompson and Taylor (1933) <sup>16</sup>
5	Rubidium	640	200	Goldschmidt (1937) <sup>16</sup>
6	Silicon	515	10–1,000	Armstrong (1951) <sup>16</sup>
			(depending on depth)	
7	Lithium	160	100	Thomas and Thompson (1933) <sup>16</sup>
8	Iron	160	15–50	Thompson and Bremner (1935) <sup>16</sup>
9	Iodine	44	50	Reith, Schultz (1930) <sup>16</sup>
10	Phosphorus	41	0–90	Barnes (1951) <sup>14</sup>
11	Copper	30	1–25	Chow and Thompson (1952) <sup>12</sup>
12	Aluminium	26.8	27–270	Armstrong (1951) <sup>16</sup>
			160–1,800	Haendler and Thompson (1939) <sup>17</sup>
13	Manganese	2.5	1–10	Thompson and Wilson (1935) <sup>16</sup>
14	Arsenic	0.46	1.6–5	Smales and Pate (1952) <sup>16</sup>
				Ishibashi <i>et al.</i> (1951) <sup>16</sup>

## ANALYSIS

1. *Bromine*.—The bromine in sea-water was oxidised to bromate and determined iodometrically.<sup>5</sup>

2. *Strontium*.—After separation of Iron and Aluminium from sea-water (volume 5 litres) Ca<sup>++</sup> and Sr<sup>++</sup> were precipitated as oxalates and the oxalates converted to nitrates. From the mixed nitrates, strontium nitrate was extracted with alcohol and ether and then estimated as strontium sulphate.<sup>2</sup>

3. *Boron*.—The method depends on the fact that boric acid titrates as fairly strong acid

separated as cobaltinitrites. The precipitate was dissolved in hydrochloric acid and cobalt separated from the mixture as sulphide by passing H<sub>2</sub>S gas. The filtrate was used for estimating rubidium after separation of NaCl and KCl using concentrated hydrochloric acid. Rubidium was precipitated by adding a boiling solution of 25% stannic chloride. The precipitate was filtered, washed with alcohol, dried at 120° C. and weighed as Rb<sub>2</sub> Sn Cl<sub>6</sub>.<sup>7</sup>

6. *Silicon*.—Silicon was estimated colorimetrically by forming a yellow molybdenum complex with ammonium molybdate reagent in

presence of mineral acid.<sup>9</sup> The colour developed with the sea-water sample was compared with that of the standard solutions in the range from 0 to 1.0 mg. silicon per litre.

7. *Lithium*.—100 litres of sea-water were evaporated down to 4 litres thereby separating the major portion of the constituents such as NaCl, CaSO<sub>4</sub>, etc. From the concentrated brine (4 litres) magnesium was separated as magnesium carbonate. Lithium and the residual magnesium in the filtrate were precipitated together as phosphates and weighed as Li<sub>3</sub>PO<sub>4</sub> + Mg NH<sub>4</sub> PO<sub>4</sub> · 6 H<sub>2</sub>O.<sup>8</sup> Magnesium content from this mixture was estimated separately by EDTA titration and lithium content was calculated by difference from the mixed precipitate.

8. *Iron*.—100 ml. of sea-water were acidified with sulphuric acid and the solution evaporated to dryness. The residue was extracted with water and ferrous ions were oxidised and the ferric ion estimated colorimetrically using KCNS solution<sup>2</sup> (p. 486).

9. *Iodine*.—The method is based on the catalytic effect of the liberated iodine on the reduction of ceric salt by arsenious acid in sulphuric acid solution. The reduction is determined by arresting the reaction at a given time by the addition of excess of ferrous solution followed by thiocyanate solution. The red colour of ferric thiocyanate is measured colorimetrically at wavelength 488 mμ. The depth of this colour is inversely related to the iodide concentration.<sup>6</sup> The amount of iodine is deduced from a previously prepared calibration graph with solutions containing 0.01 to 0.1 mg. iodine per litre.

10. *Phosphorus*.—Total phosphorus content of sea-water was determined colorimetrically after the oxidation of organic phosphorus with perchloric acid.<sup>10</sup> The phosphomolybdate complex colour was developed with ammonium molybdate and compared with standard solutions (range 0.0 to 100 microgram of P per litre).

11. *Copper*.—The method reported by Chow and Thompson<sup>12</sup> for colorimetric estimation of copper using diethyl dithiocarbamate as colour-forming agent was adopted.

12. *Aluminium*.—Aluminium content in 50 ml. sea-water was estimated colorimetrically

using 8-hydroxy-quinoline reagent and comparing the colour developed with the standard solutions in a Dubosq colorimeter<sup>9</sup> (p. 26).

13. *Manganese*.—The method reported by Barnes<sup>11</sup> for colorimetric estimation of manganese from sea-water was used. Manganese in sea-water was oxidised to permanganate and the colour compared with standard permanganate solutions in the range 0.0 to 10 μgm. Mn per litre.

14. *Arsenic*.—One litre of sea-water was concentrated to 250 ml. Arsenic was estimated from this solution according to the method given in Analar standards for traces of arsenic in salt solutions.<sup>13</sup> The stains produced on mercuric chloride paper were compared with stains produced from known amounts of arsenic.

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## ON THE OCCURRENCE OF CRUSH-BRECCIA IN SINGHBHUM GRANITE, BIHAR

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IN the course of detailed structural mapping of the Singhbhum granite, an interesting and unusual group of breccia rock was observed in two widely separated localities, as follows:

(1) The breccia rocks along a north-south elongated zone (500' × 250') near the village Phuphundi (long. 86° 07' E. : lat. 22° 35' N.) (Fig. 1) consist of angular fragments, ranging from a few mm. to 60 cm. across, of leucogranite, hornblende granodiorite, amphibolite, metagabbro and epidiorite, set in a fine-grained, greenish-grey, mylonitic matrix.

(2) The elongated body of breccia rock (250' × 50') in the hornblende granodiorite country near Barasai (86° 12' : 22° 38') consists of angular fragments of leucogranite and hornblende granodiorite in a fine-grained, greyish-green, chlorite-rich, foliated groundmass.

The brecciated rocks at the former locality are exposed better and have been studied in some detail. The country rock here is hornblende granodiorite with numerous patches of epidiorite and metagabbro (up to ¼ mile in length). Exposures of unsheared hornblende granodiorite with irregular injections of pegmatite lie to the west and south-west of the breccia zone. Along the southern and eastern margins of the breccia zone lies a large exposure of sheared metagabbro, cut by a number of thin veins of unsheared aplogranite. Two narrow dykes of unsheared Newer Dolerite (Dunn and Dey, 1942) cut across the breccia as well as the metagabbro (Fig. 1).

The matrix of the breccia shows well-developed schistosity as well as close-spaced fracture cleavage, both trending between NNW and NNE with easterly dips of 60°–80°. A downdip striation lineation is conspicuous, while there are local slickensides along the planes of fracture cleavage. Fracture cleavages in the sheared metagabbros appear to be continuous with those in the breccia.

The fragments in the breccia are usually triangular, rectangular and elliptical in outline (Fig. 2). The metagabbroic fragments consist of saussuritized plagioclase and aggregates of hornblende, actinolite and rare augite; the rock shows relic doleritic texture. The fragments of granodiorite consist of oligoclase, quartz, together with small quantities of chlorite, hornblende, epidote, sphene and apatite. The

amphibolites consist mainly of a granoblastic aggregate of hornblende and plagioclase with some quartz, sphene and iron ore. The epidiorites consist chiefly of actinolite and saussuritized plagioclase and show a crude schistosity due to parallelism of actinolite.

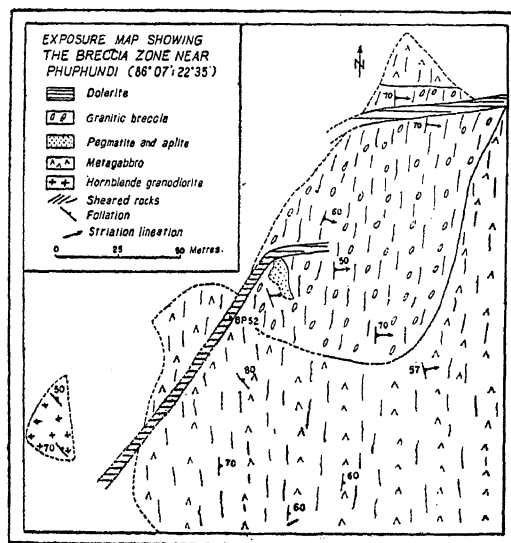


FIG. 1. Breccia zone near Phuphundi.

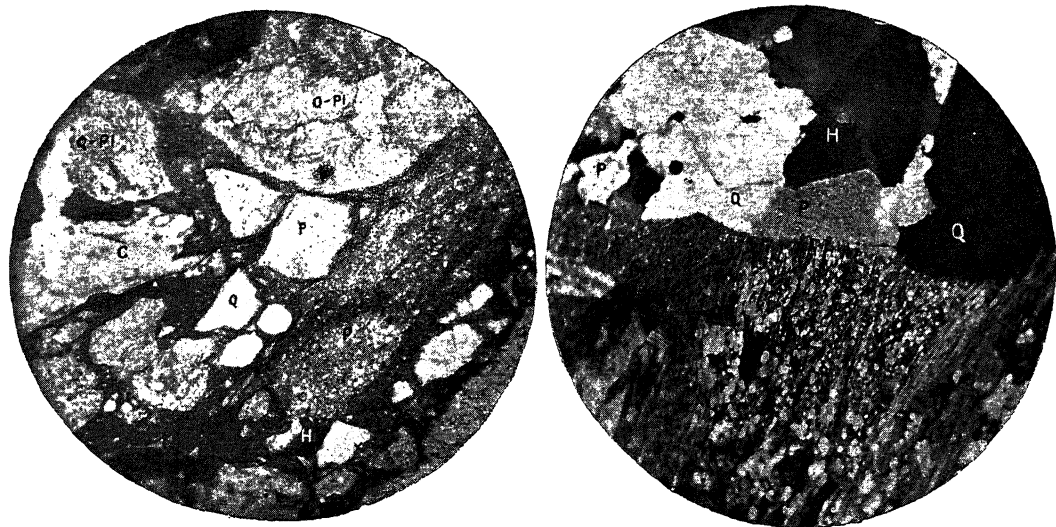
The matrix consists of highly saussuritized quartz, sheared and elongated oligoclase, needles of actinolite ( $N_z = 1.641$ ), and fine flakes of sericite and chlorite. The pronounced schistosity due to parallelism of actinolite and sericite tends to abut against the larger fragments (Fig. 3), but it distinctly swerves around the smaller rock fragments (< 1 mm.). In places, the mylonitic matrix penetrates into the rock fragments as thin veins. The mineralogical composition of the matrix is uniform, and was probably granodioritic originally, though some of its constituents have obviously been incorporated by crushing of the fragments of leucogranite and basic rocks.

The interior of the larger fragments is un-sheared, but a thin marginal zone (up to 1 mm. wide) of these fragments shows intense granulation and strain effects in the constituent minerals, as follows:—(1) quartz has been pulverized and at places pushed out of the enclosing material as veins, and ultimately

merged with the mylonitic matrix outside the fragment; (2) plagioclase has been intensely sericitized and its twin-lamellæ bent; (3) hornblende grains are bent and tremolitized.

the matrix has probably been facilitated by its original fine-grained nature.

The few narrow veins of unsheared aplite and pegmatite cutting across the breccia zone



FIGS. 2-3. Fig. 2. Photomicrograph of granite breccia, showing angular fragments of quartz (Q), plagioclase (P), quartz-plagioclase rock (Q-Pi), chlorite (C) and hornblende (H) in a fine-grained, schistose groundmass of quartz, plagioclase and chlorite. Plane polarised light,  $\times 19$ . Fig. 3. Photomicrograph of granite breccia. Schistosity of groundmass (Quartz feldspar actinolite mylonite) abutting against a large fragment of granodiorite which is composed of quartz (Q), plagioclase (P) and hornblende (H); the schistosity tends to wrap the fragment around one of its sides (*right*). Crossed nicols,  $\times 19$ .

The elongated nature of the zones of breccia at both Phuphundi and Barasai, and the presence of a large variety of rock types amongst the fragments, suggest that these zones are not merely crush zones, but are faults in the hornblende granodiorite country (with patches of leucogranite and basic metamorphic rocks). The intense crushing of the matrix of the breccia, in sharp contrast with the absence of shearing in the interior of the bigger fragments, is probably due to the fault movements having taken place at considerable depth below the surface where the strength of the affected rocks would be higher than on the surface. The crushing of the materials represented by

(Fig. 1) indicate that the fault movements occurred before the introduction of the aplite-pegmatite. Since the aplite-pegmatite belong to a late phase of the emplacement of Singhbhum granite, the fault movements probably occurred shortly after the formation of the granite.

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## COPPER RESISTANT STRAIN OF *SCLEROTIUM ROLFSII*

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CHEMICAL control of plant diseases has come to stay particularly because of the breakdown of varieties in the ever-changing population of phytopathogenic fungi which are throwing out resistant strains in nature. For the control of majority of diseases the application of fungicides has to be repeated several times during the growing period of the crop, as also from season to season to keep the disease well under control. Such regular and constant use of chemicals for plant disease control has created problems because of the possible development of strains of fungi resistant to such chemicals. Development of such resistance in certain pests has already been reported and bacteria too have exhibited acclimatisation to certain drugs in the therapy of human diseases. In fungi instances of this type have so far been rare. Taylor (1953) collected spores of *Phylospora obtusa* from many orchards and found greater tolerance to Bordeaux Mixture in spores which had been collected from sprayed orchards than those where no spray of the fungicide had been given. Horsfall (1956) has also predicted that development of resistance to more and more specialised fungicides is likely to create problems for the practical man. For such studies a general parasite like *Sclerotium rolfii* which attacks a variety of hosts and for control purposes is subjected to fungicidal treatment periodically, was considered more suitable and was employed in the experiments reported herein. The fungus was exposed to treatment of Fytolan (50% copper oxychloride) for several generations under experimental conditions in the laboratory, to see if there was any indication of acclimatisation.

*Sclerotium rolfii* was grown on Potato-Dextrose-Agar and various concentrations of the fungicide were obtained by adding known quantity of Fytolan to a measured amount of medium when it was slightly hot and in a liquid condition. The mixture was thoroughly shaken in order to secure uniform dispersal of the fungicide before pouring it into sterile petriplates. Sub-culturing of the fungus during different generations was done through single sclerotium. The number of sclerotia were counted in different treatments after growth period of three weeks while the diameter of the colony was recorded after an interval of seven days.

Initial studies showed that the parent strain could successfully grow up to a concentration of 7,000 p.p.m. of the fungicides but at 8,000 p.p.m. the growth was completely inhibited. However if the inoculum from 7,000 p.p.m. was transferred to 8,000 p.p.m., the fungus grew well. In this manner the concentration of the fungicide was gradually increased at different levels and by successive transfer of sclerotia from media containing lower doses of the chemical to media containing higher doses, a resistant strain of *S. rolfii* was obtained which could successfully grow on 30,000 p.p.m. of Fytolan. The whole process was achieved in fourteen transfer generations. The new strain had thicker mycelium and bigger sclerotia as compared with the parent strain but the number of sclerotia decreased by 80%.

The adaptation of *S. rolfii* to Fytolan can be attributed to certain physiological changes which might have occurred in successive transfer generations. Hirt (1949) was able to grow successfully *Poria xantha* on media containing copper and suggested the tolerance to be due to rhizomorphic structures which survive until the fungus had become adapted. Stakman *et al.* (1946) working with haploid lines of maize smut observed that tolerance power of this fungus to increasing concentrations of arsenic could be raised to a considerable degree. Christensen (1946) was able to develop resistance in *Gibberella zeae* to mercuric chloride and ethylmercury phosphate by successive transfer of inoculum from media containing lower concentration of fungicide to media containing higher doses. Wilson (1947) observed that there was no sclerotia formation in *S. rolfii* and *S. delphinii* growing on a media having arsenic. In our studies, however, sclerotia formation was observed in all the transfer generations although the number decreased with increased concentrations.

In order to compare the characters which the fungus had developed in different generations, the sclerotia from the highest concentrations were grown on all the lower concentrations of that particular generation, and changes with respect to reduction in number of sclerotia and growth of fungus were recorded for different treatments. The data in respect of a few generations are presented in Figs. 1 & 2 which

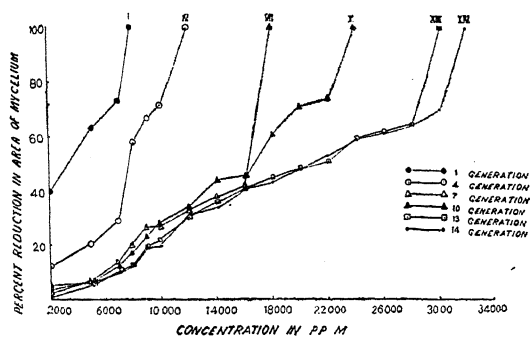


FIG. 1. Effect of increasing concentrations of fytolan on the mycelial growth of *S. rolfsii*.

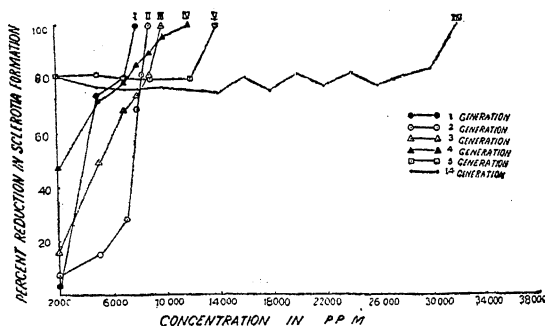
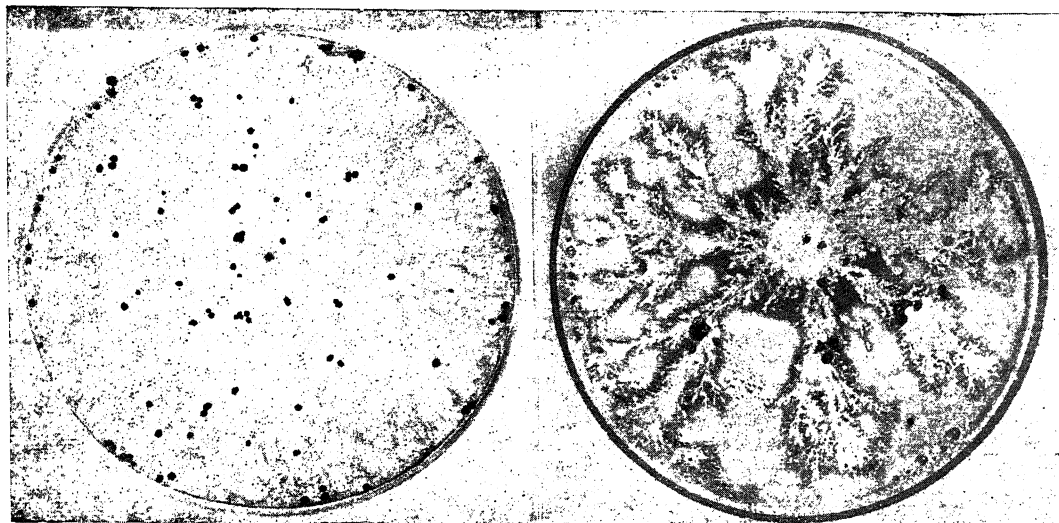


FIG. 2. Effect of increasing concentrations of fytolan on the sclerotia formation of *S. rolfsii*.



FIGS. 3-4. *Sclerotium rolfsii*. Fig. 3. Parent strain on potato dextrose agar. Fig. 4. Resistant strain on 30,000 p.p.m. of fytolan (copper oxychloride).

show that the ability of *S. rolfsii* to grow on the same concentration of Fytolan increased with successive transfer generations. There is a rapid reduction in the percentage of sclerotia up to 5th generation after which it becomes stable up to 14th generation.

The resistant strain so obtained was grown on a fungicide-free medium for three successive generations to see if the resistance acquired by it had come to stay. It was observed that it had similarities with the parent strain in type of mycelial growth and size of sclerotia but formed fewer sclerotial bodies. When it was again transferred back to a medium containing 30,000 p.p.m. of Fytolan, it grew well exhi-

biting typical characters of the resistant strain (Figs. 3-4).

The author wishes to express her gratitude to Dr. R. S. Vasudeva, for keen interest during the progress of this study. Thanks are also due to Dr. J. S. Grewal and Mr. Dharam Vir for their helpful suggestions.

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## LETTERS TO THE EDITOR

CHLORINE PURE QUADRUPOLE  
RESONANCE IN SOME  
MULTI-SUBSTITUTED BENZENES

In continuation of the resonances reported<sup>1</sup> earlier from this laboratory pure quadrupole resonance of  $\text{Cl}^{35}$  has been observed in twelve solid multi-substituted benzenes at room temperature ( $30.5^\circ\text{C}$ ). Resonances for eight of these compounds have been reported earlier at  $77^\circ\text{K}$ . The data for the remaining four compounds are reported in this note for the first time.

The resonances were detected with a frequency modulated self-quenching super-regenerative oscillator. Frequencies were measured using a BC-221Q frequency meter. The frequency accuracy is estimated as less than  $\pm 10\text{ Kc./s}$ . In compounds (3), (4), (5) only one line could be observed at room temperature. The frequencies together with the available literature values at  $77^\circ\text{K}$ . are presented in Table I.

TABLE I

Compound	Resonance frequency $\nu$ in Mc./s.	Literature value for $\nu_{\text{Cl}^{35}}$
1. 2, 4-Dichloro Aniline	.. 34.20, 34.33	34.734, 34.854, <sup>2</sup>
2. 2, 5-Dichloro Aniline	.. 33.90, 34.00	34.413, 34.530, <sup>4</sup>
3. 3, 4-Dichloro Aniline	.. 35.11	35.673, 35.872, <sup>2</sup>
4. 2, 4, 6-Trichloro Aniline	.. 34.49	34.925, 34.976, 35.177, <sup>3</sup> 35.591, 35.780, 35.885
5. 2, 4, 6-Trichloro Phenol	.. 34.73	36.770, 35.400, 35.262 <sup>2</sup>
6. 4-chloro-3-OH Toluene ( <i>p</i> -chloro- <i>m</i> cresol)	34.53, 34.13	..
7. 4-Chloro 2-Nitro Toluene	.. 34.65	..
8. 2-Chloro-4-Nitro Toluene	.. 34.44	..
9. 6-Chloro 2-Nitro Toluene	.. 34.45	35.219 <sup>2</sup>
10. 6-Chloro 3-Nitro Toluene	.. 34.50	..
11. <i>p</i> -Nitro Benzyl Chloride	.. 32.68	34.311 <sup>4</sup>
12. 2, 4 Dichloro Phenoxy Acetic Acid	34.62, 35.64	35.146 <sup>2</sup> 36.226

In compounds (4) to (12) resonances were detected in samples melted initially in vials. The resonances detected in compounds (5) and (10) are very weak and had to be brought out of the noise with an increased extent of

frequency modulation. The error in frequency measurements in these compounds may consequently be somewhat higher.

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Andhra, University, Waltair,  
May 18, 1962.

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POSSIBLE USE OF 2-HYDROXY  
1, 4-NAPHTHOQUINONE IN THE  
ESTIMATION OF SOME UNCOMMON  
METALS

LAL AND DUTT<sup>1</sup> reported that 2-hydroxy 1, 4-naphthoquinone gives an orange precipitate with lead acetate, a deep red colour with nickel acetate and a reddish brown colour with ferric chloride. Nagase and Matsumoto<sup>2</sup> have reported that 2-hydroxy 1, 4-naphthoquinone shows colour reactions which are not sensitive with Ni (II), Co (II), Hg (II), and Cu at pH 6.8 and forms lakes with Bi (III), Al (III), and Fe (III) at pH 3.2. It has now been found that 2-hydroxy 1, 4-naphthoquinone completely precipitates thorium, zirconium and uranium in the pH range 4.5–5.5, 3.0–4.5, and 4.5–5.5 respectively. Cerium (IV) and lanthanum are only partially precipitated in the pH range 3.5–7.0. Thorium forms an orange-coloured complex with 2-hydroxy 1, 4-naphthoquinone which has maximum absorption at  $435\text{ m}\mu$  and as the reagent itself has considerable absorption at  $435\text{ m}\mu$ , this reaction is not suitable for spectrophotometric estimation of thorium.

GRAVIMETRIC DETERMINATION OF THORIUM,  
ZIRCONIUM, URANIUM, CERIUM (IV) AND  
LANTHANUM

To 150–200 ml. of solution containing 10–40 mg. of the metal ions about 0.5 gm. of 2-hydroxy 1, 4-naphthoquinone was slowly added with thorough stirring, the pH of the solution being suitably adjusted with ammonia or dilute hydrochloric acid. The resultant solution, after heating on a steam-bath for 1–2 minutes, was cooled to room temperature and filtered through Whatman filter paper no. 40. The precipitate was washed

with an aqueous solution of 2-hydroxy 1, 4-naphthoquinone adjusted to the same pH at which complex formation took place, dried at 110° C. and ignited to the oxide. Tables I-V give the results of the estimation of thorium, zirconium, uranium, cerium (IV) and lanthanum respectively.

TABLE I

ThO <sub>2</sub> taken, mg. (oxine method)	9.0							
ThO <sub>2</sub> found, mg.	3.3	8.0	8.3	8.7	9.0	9.0	9.0	9.0
pH	2.5	3.0	3.5	4.0	4.5	5.0	5.5	5.5

TABLE II

ZrO <sub>2</sub> taken, mg. (oxine method)	12.8							
ZrO <sub>2</sub> found, mg.	11.3	12.7	12.8	12.8	12.8	12.8	12.8	12.8
pH	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5

TABLE III

U <sub>3</sub> O <sub>8</sub> taken, mg. (oxine method)	38.5							
U <sub>3</sub> O <sub>8</sub> found, mg.	18.9	15.7	36.4	38.5	38.6	38.5	34.5	19.2
pH	2.1	3.5	4.0	4.5	4.9	5.5	6.1	7.0

TABLE IV

CeO <sub>2</sub> taken, mg. (oxine method)	12.2							
CeO <sub>2</sub> found, mg.	11.0	11.1	11.5	11.2	10.8	10.3	2.9	
pH	3.5	4.0	4.5	4.8	5.7	6.5	7.3	

TABLE V

La <sub>2</sub> O <sub>3</sub> taken, mg. (oxine method)	23.3							
La <sub>2</sub> O <sub>3</sub> found, mg.	1.0	7.5	18.3	18.0	19.1	21.6		
pH	3.6	4.5	5.2	5.5	6.2	7.0		

#### SPECTROPHOTOMETRIC STUDY OF THE THORIUM COMPLEX

Thorium, uranyl and lanthanum solutions at pH 3.5 give orange-coloured complexes with an alcoholic solution of 2-hydroxy 1, 4-naphthoquinone. The thorium complex with 2-hydroxy 1, 4-naphthoquinone has been studied spectrophotometrically; curve 1 in the figure represents the absorption due to a solution containing 5 ml. of 10<sup>-3</sup> M alcoholic 2-hydroxy 1, 4-naphthoquinone and 5 ml. of water while curve 2 represents the absorption due to a solution containing 5 ml. of 10<sup>-3</sup> M alcoholic 2-hydroxy-1, 4-naphthoquinone and 5 ml. of 10<sup>-3</sup> M thorium solution.

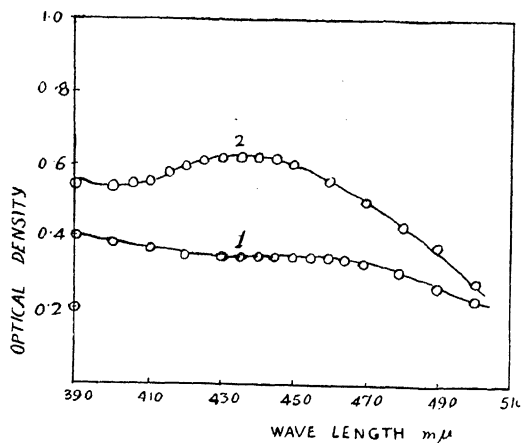


FIG. 1. 1. Absorption spectrum of 2-hydroxy 1, 4-naphthoquinone. 2. Absorption spectrum of 2-hydroxy 1, 4-naphthoquinone-thorium complex.

Our thanks are due to Prof. T. R. Seshadri, F.R.S., for his keen interest and helpful discussions.

Dept. of Chemistry,  
University of Delhi,  
Delhi-6, June 19, 1962.

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S. P. SINGHAL.

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#### A SIMPLE METHOD OF CALCULATING THE CROSSING OVER PERCENTAGE FROM THE F<sub>2</sub> DATA

THE study of linkage relations is of great significance in genetics. Backcross is the usual method of finding out the crossing over percentage but where the backcross fails, one has to depend upon the F<sub>2</sub> data for calculation. According to Riley<sup>2</sup> calculation of crossing over percentage from F<sub>2</sub> data is a tedious task and one of the best formulæ used for it is that of Immer, viz.,

$$\frac{ad}{bc} = \frac{2p^2 + p^4}{1 - 2p^2 + p^4}$$

or

$$p = \sqrt{\frac{-(bc+ad) + \sqrt{(bc+ad)^2 + ad(bc-ad)}}{(bc-ad)}}$$

where  $p$  is the percentage of crossing over in the repulsion phase, or  $(1 - p)$  is the percentage in the coupling phase, and  $a$ ,  $b$ ,  $c$  and  $d$  represent, respectively, the AB, Ab, aB and ab classes.

The author presents the following simple formulæ for the calculation of crossing over

percentage from the  $F_2$  data:—

Coupling phase

$$p = \left(1 - \sqrt{\frac{ab}{T}} \times 2\right) \times 100 \quad (1)$$

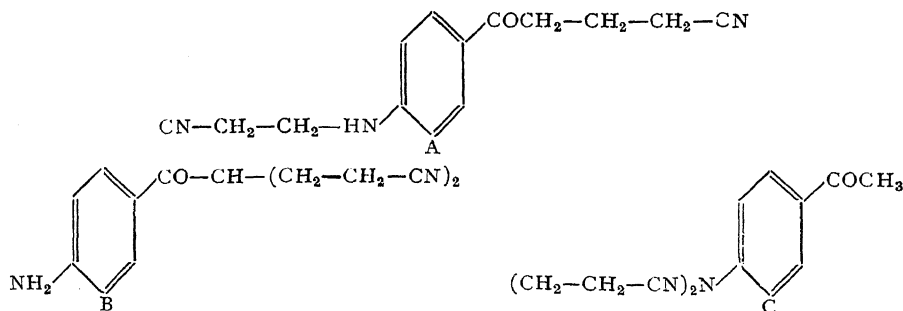
Repulsion phase

$$p = \left(\sqrt{\frac{ab}{T}} \times 2\right) \times 100 \quad (2)$$

where  $p$  is the percentage of crossing over,  $T$  is the total population of  $F_2$  and  $ab$  is the double recessive class.

The following examples will elucidate the formulæ more clearly:—

*Example 1.*—Bateson and Punnett made a cross between purple flowered and long pollen parent against red flowered, round pollen parent



in sweet pea. The  $F_1$  was purple long and the  $F_2$  progeny was:—

Purple long Purple round Red long Red round

177                  15                  15                  49

In this cross the percentage of crossing over can be calculated by formula (1)

Thus

$$p = \left(1 - \sqrt{\frac{49}{256}} \times 2\right) \times 100 = 12.5\%$$

*Example 2.*—In the repulsion phase these workers obtained the following progeny:—

Purple long Purple round Red long Red round

226                  95                  97                  1

According to (2)

$$p = \left(\sqrt{\frac{1}{419}} \times 2\right) \times 100 = 9.8\%$$

The above results are in conformity with the results obtained by Immer's method.

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Kanpur, January 25, 1962.

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## STUDIES IN CYANOETHYLATION

DURING the course of studies in cyanoethylation we investigated the reaction of *p*-aminoacetophenone (I) with acrylonitrile (II).

One mole of (I) and four moles of (II) were heated together in dioxan solution in the presence of triton-B at 30 to 40° C. for about two hours. After diluting the mixture with ice and acetic acid, it was kept overnight in a refrigerator when a colourless solid separated out. It could be crystallised from benzene or ethylacetate in colourless needles, m.p. 135° C. (Found: C, 69.6; H, 6.4; N, 17.0%.  $C_{14}H_{15}N_3O$  requires C, 69.7; H, 6.3; N, 17.4%).

The results of analysis indicate that the condensation product (III) could have one of the following structures:

Hydrolysis of III with potassium hydroxide yielded colourless needles of an acid crystallised from water, m.p. 142° C. (Found: C, 59.8; H, 6.1; N, 5.2%.  $C_{14}H_{17}NO_5$  requires C, 60.22; H, 6.09; N, 5.02%).

The molecular weight of the acid by the silver-salt method was found to be 251 which agrees with the calculated value at 279 for a dibasic acid.

The compound III fails to give an acetyl derivative nor does it form a quaternary salt on treatment with methyl iodide. These observations rule out the possibility of structures B and C for III. The latter on treatment with nitrous acid gives a yellow crystalline derivative crystallisable from alcohol having m.p. 125° which gives the Liebermann's test for N-nitrosoamines. (Found: N, 21;  $C_{14}H_{14}N_4O_2$  requires N, 20.6%).

These data support the structure A for III which is also obtained by reaction of I and two moles of II at 30° C. or at higher temperatures.

Further work on structure III is in progress and will be reported elsewhere.

Institute of Science,  
Bombay, April 10, 1962.

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### KINETICS OF AUTOXIDATION OF ASCORBIC ACID

THE kinetics of autoxidation of ascorbic acid has been studied mostly in the presence of metal ion catalysts in aqueous solution. The results reported and the conclusions drawn vary.<sup>1-3</sup> There is however general agreement

about half an hour. The data for a particular run are given below:

The mean value for the first-order velocity constant calculated,  $7.38 \times 10^{-2}$  per min. at  $29.6^\circ \text{C}$ . and pH 6.06, differs from previously reported values by a degree unaccountable by temperature or pH differences.

Temperature  $29.6^\circ \text{C}$ .

Time in mins.	0	5	9	15	19.5	25	30.1	35	40
Absorbancy	1.26	0.875	0.64	0.41	0.295	0.205	0.17	0.145	0.145

that the oxygen absorbed during autoxidation is only partly used for the oxidation of ascorbic acid to dehydroascorbic acid while the rest is used up in the formation of hydrogen peroxide (oxygen absorbed in excess of 0.5 mole per mole of ascorbic acid being ascribed to the formation of hydrogen peroxide). Measurement of the rate of autoxidation of ascorbic acid in terms of the volume of oxygen absorbed is subject to error on this account. Peterson and Walton<sup>1</sup> reported by measurement of oxygen absorption that no appreciable autoxidation of ascorbic acid occurred below pH 8 of the medium in the absence of catalysts and at pH 8, the first order velocity constant had a value  $8.5 \times 10^{-4}$  per min. at  $25^\circ \text{C}$ . Schummer<sup>4</sup> reported a value,  $2.51 \times 10^{-4}$  per min. in purely aqueous solution and  $1.55 \times 10^{-3}$  in a solution of sodium phosphate at pH 7, both at  $20^\circ \text{C}$ . The reaction was followed by titration with 2, 6-dichlorophenol indophenol.

Mohler and Lohr<sup>5</sup> used a spectrophotometer for the estimation of ascorbic acid. This method, being direct and reasonably accurate, has now been employed for the study of the rate of autoxidation of ascorbic acid.

As the rate of autoxidation of ascorbic acid was influenced by change of pH, it was necessary to use a buffer for preparing its solution. Potassium biphosphate buffer of pH 6.06 was aerated by drawing air through and 0.01-0.02 gm. of ascorbic acid (B.D.H. Reagent, m.p.  $190^\circ \text{C}$ .) was dissolved in 150 ml. of the buffer solution. A sample of the solution was transferred to the spectrophotometric cell with the least delay. The absorbancy of the solution was measured using a Hilger Spectrophotometer at  $2500 \text{ \AA}$ , the buffer alone serving as blank. At regular intervals, fresh samples of the solution, kept shaken in a thermostat, were taken in the cell and absorbancies measured. In order to ensure conformity with Beer's law, it was necessary to have the initial concentration of ascorbic acid so chosen as not to have an absorbancy too high. The reaction proceeded to near completion in

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### A NEW COLORIMETRIC METHOD FOR THE ESTIMATION OF CAFFEINE IN BEVERAGES

A NUMBER of colorimetric methods<sup>1-3</sup> have been applied to the estimation of caffeine in natural and non-alcoholic beverages. The method described in this note is based on the colour reaction given by tertiary amines with malonic acid and acetic anhydride.<sup>4</sup> The results obtained from preliminary studies, employing various carboxylic acids and dehydrating agents have shown that the colour reaction with malonic acid-acetic anhydride may be used for the quantitative estimation of caffeine in beverages.

The first part of the experiment consists in standardising the method by applying it to pure caffeine. For this the most suitable procedure is to treat anhydrous caffeine (caffeine B.P. purified by sublimation and dried at  $100^\circ \text{C}$ . for four hours) with a 2% solution of malonic acid in acetic anhydride and to develop the colour by heating in a water-bath, under anhydrous conditions, at  $85-90^\circ \text{C}$ . for 10 mins. The initial orange-yellow solution, thus obtained, turns greenish-yellow on suitable dilution with methanol. This colour is measured colorimetrically with a Hilger Biochem Absorptiometer using the  $430 \text{ m}\mu$  filter and a half cm. cell.

The results obtained in the various concentrations of the standards indicate that Beer's Law is obeyed in this particular case in the con-



centration range of 10 to 50 mg. of caffeine/ml. A number of experiments on these standards were repeated and reproducible results were obtained. The average optical density values obtained for the various concentrations are shown in the standard curve in Fig. 1.

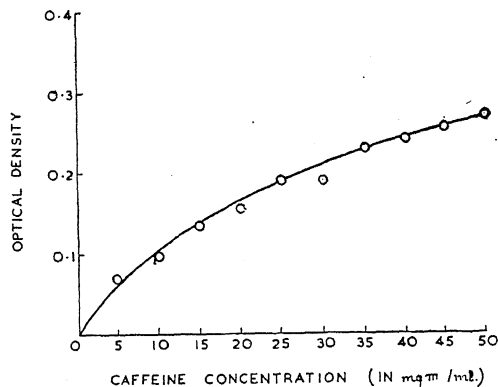


FIG. 1

The method after standardisation was employed for the estimation of caffeine in certain beverages like coffee, tea and coca-cola. The caffeine itself was extracted from these beverages by the usual methods described in literature.<sup>5</sup> The results obtained are given in Table I. These results agree fairly well with the values reported in literature.<sup>6-8</sup> Recovery tests were also carried out. The recovery values obtained for these beverages are also given in Table I.

TABLE I  
Caffeine content of certain beverages as determined by the new colorimetric method

Beverage	Caffeine present		Recovery %
	Value determined by the new colorimetric method	Value reported in literature	
Coca-Cola	.. 23.5 mg./100 ml.	19.53 mg./100 ml. <sup>6</sup>	103.9
Coffee—Roasted (amixture of Robusta, Peaberry and Plantation)	.. 2.67%	2.2–2.6% <sup>7</sup>	106.8
Tea (Brooke-Bond Green Label Leaves)	.. 4.54%	1.0–4.7% <sup>8</sup>	118.5

The results obtained from a number of experiments indicate that this is a rapid method for the estimation of caffeine and can easily be employed for determination of this alkaloid in beverages.

The authors wish to thank Miss Surinder Kaur of Defence Science Laboratory, Delhi, for technical assistance at the initial stages; the Director, Defence Science Laboratory, Delhi, for having provided the necessary facilities and the Research and Development Organisation, Ministry of Defence, for the award of a Research Fellowship to one of them (K. S. J.).

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February 1, 1962.

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### AN EFFICIENT ORGANIC SOURCE OF PHOSPHORUS FOR NUTRIENT CULTURE OF RICE

PHOSPHORUS, in combination with iron, is said to play a singular role in the maintenance of nutrient balance in solution-culture experiments.<sup>1,2</sup> Majumder and Dunn<sup>3</sup> reported earlier that ethyl ammonium phosphate (EAP) could successfully substitute potassium dihydrogen phosphate as a source of phosphorus for maize in nutrient culture. The present investigation is concerned with the testing of the efficiency of EAP as compared to sodium and potassium dihydrogen phosphates as a source of phosphorus in the nutrient culture of rice.

The base nutrient solution used was the same as that described earlier by Tanaka *et al.*<sup>4</sup> except for the variations in phosphorus sources. The concentration of phosphorus for all the treatments was 20 p.p.m. as  $P_2O_5$ , and the additional nitrogen in EAP was compensated for in the other two treatments. There were seven replications per treatment, each consisting of a 4-litre glazed porcelain pot with two plants in it. The variety of rice used was Ptb 10 with a maturation period of about 110 days. Four

periodic samples were taken for phosphorus estimation when the plants were 40, 60, 70 and 110 days old, and the results of the last two determinations are given in Table I. The results of the first two determinations did not differ among the three phosphorus sources.

TABLE I

Percentage of phosphorus in terms of dry weights

Parts of the plant	Days from sowing	Potassium dihydrogen phosphate	Sodium dihydrogen phosphate	Ethyl ammonium phosphate
Shoot	70	0.32	0.30	0.26
	110	0.1375	0.1015	0.085
Root	70	0.190	0.150	0.150
	110	0.096	0.0815	0.064
Very young emergent panicle	70	0.32	0.295	0.300
Grain	110	0.367	0.3245	0.328

From a scrutiny of the harvest data on height, ear-bearing tillers, yield of grain and 1000 grain weight, it was evident that EAP was at par with the other sources of phosphorus and can be used as a substitute for the nutrient culture of rice. This observation becomes particularly useful in view of the fact that EAP does not dissociate in solution and the possibility of interaction between free phosphorus and iron at unfavourable pH-levels is eliminated.

Chemical analysis of different parts of the plant as presented in Table I indicates that plants, receiving potassium dihydrogen phosphate, absorbed and accumulated the maximum quantity of phosphorus at all stages, although this enhanced phosphorus-uptake was not reflected in the yield of grain. The corresponding percentage values for plants receiving sodium dihydrogen phosphate, however, were slightly, but consistently, less. On the other hand, plants receiving EAP absorbed and accumulated less phosphorus than in the other two treatments at all stages except in the reproductive phase. It is possible that higher phosphorus accumulation in the reproductive parts aided the vital process of grain-setting and maturation and was responsible for bringing the yield in the EAP-treated plants up to par with others.

The data suggest that phosphorus from EAP is efficiently utilized by rice plants.

We wish to thank Dr. R. H. Richharia, Director, for providing us with necessary

facilities and the Monsanto Chemical Company, U.S.A., for the free sample of ethyl ammonium phosphate.

Central Rice Res. Inst., S. K. MAJUMDER.  
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### AN ENZYMATIC PROCEDURE FOR THE EXTRACTION OF ALKALOIDS FROM *RAUVOLFIA SERPENTINA* BENTH.

ENZYMES<sup>1-3</sup> have been used for the purification of alkaloids in a few methods for analysing crude drugs. These observations led the present author to try to utilize a carbohydrate-splitting enzyme for the extraction of alkaloids in *R. serpentina* roots. The large amount of starch present in the drug indicated that Taka-Diastase (Parke-Davis) could be used to advantage, as it digests about 350 times its weight of starch. The two varieties of the drug worked upon were the "Himalayan variety" and the "Assam variety". The roots after sun-drying and removal of gritty matter were powdered in a laboratory mill into No. 40 powder and stored in stoppered air-tight containers to prevent absorption of moisture and mold contamination. A known quantity of the powdered drug was transferred to a flask and its starch content gelatinised with water by immersing the flask in boiling water for half an hour. The mixture was allowed to cool, and digested with Taka-Diastase at 55°C. for about 15 minutes, till a drop of the homogeneous mass gave no blue colour when added to one drop of iodine T.S. The resulting mixture, after basifying with ammoniacal alcohol B.P., was transferred quantitatively to a continuous extraction apparatus and extracted with a solvent mixture of alcohol and chloroform (2:1 v/v) for about an hour. After the complete removal of solvent the residue was extracted, first with successive quantities of hot water, and then with successive portions of N/2 sulphuric acid. The acid extracts were allowed to pass through the same filter through which the aqueous extracts were previously filtered and the resulting extract, after washing with chloroform, was made alkaline with concentrated ammonia. The bases thus precipitated were

extracted with successive quantities of chloroform till no more alkaloid could be extracted. Then dilute sodium hydroxide was added to it and extraction with further successive portions of chloroform was continued till no more alkaloid was extractable. Thereafter the solvent was completely removed and the residue was dried on a water-bath for nearly an hour, when it attained a constant weight. The average results thus obtained are given in Table I, together with the corresponding values obtained by the B.P.C. or I.P. assay procedures.

TABLE I

Sl. No.	Procedure followed	%w/w of stronger bases in Himalayan variety	Assam variety
1	B.P.C. (or I.P.) ..	1.34	1.99
2	Enzymatic digestion ..	1.47	2.22

The new procedure outlined above for the complete extraction of stronger bases from the drug is relatively simple and takes only about an hour (as against more than 9 hours in extracting alkaloids from the drug by maceration in the B.P.C. procedure). The results are somewhat higher than the corresponding values obtaining by running the B.P.C. assay procedure for the drug.

I take this opportunity to express my thanks to Prof. N. K. Basu, Head of the Department of Pharmaceutics, Banaras Hindu University, for his keen interest and encouragement. My thanks are also due to the Officer-in-Charge, Government Botanical Forest Office, Shillong, for the sample of the Assam variety drug.

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#### OXYTOMIC PRINCIPLE FROM THE SEEDS OF *CASSIA TORA* LINN.

*Cassia tora* Linn. (Leguminosae), an annual herb, 30-90 cm. high, is distributed throughout India, Ceylon and the tropics generally. It grows quite abundantly in North India, particularly in Jammu region. The plant has been described in the Ayurvedic literature<sup>1</sup> as a remedy for many skin diseases. Subba Jois and

Manjunath<sup>2</sup> have examined the fixed oil of the seeds and found oleic, linoleic, palmitic and lignoceric acids along with sitosterol in the unsaponifiable matter. Ito and Ota<sup>3</sup> report a fungistatic activity to the seeds. Narayana and Rangaswamy<sup>4</sup> have also studied the seeds by extracting them with non-aqueous solvents. No work seems to have been done on the chemistry of the aqueous extractives. However, Bhatnagar *et al.*,<sup>5</sup> during their general survey and preliminary screening of plants of physiological activity, have reported that a 10% methanolic extract of the seeds has some oxytomic effect. We have now examined the seeds with a view to isolate the water-soluble active principle.

A 10% methanolic extract of the seeds has been obtained as a very viscous mass from which a brownish-white precipitate comes out on addition of excess of alcohol. The purification of the active principle has been effected by repeated dissolution in water and reprecipitation with alcohol.

The compound, obtained in a yield of 2% is brown in colour, insoluble in organic solvents, and soluble in water. It gives positive tests for nitrogen, sulphur and phosphorus. An aqueous solution of the compound gives brownish white precipitate with neutral lead acetate and basic lead acetate. The compound gives a positive Molisch test indicating the presence of carbohydrates. On hydrolysis with 10% sulphuric acid for 3 hours, it has given 48.2% of reducing sugars calculated as glucose. The sugars are identified by descending paper chromatography<sup>6</sup> to be galactose, mannose and xylose (Table I).

TABLE I

Spot No.	Rf value	Corresponding sugar	Rf value of the sugar
1	0.13	Galactose	0.13
2	0.17	Mannose	0.17
3	0.21	Xylose	0.21

The compound has shown a good oxytomic activity and even in doses of 2 µg./c. it is found to be very effective in producing contractions of the isolated uterus of guinea-pig.

The authors wish to thank Dr. K. S. Jamwal of Pharmacology Section, for determining the oxytomic properties of the isolated compound.

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### SOME ASPECTS OF THE PETRO-CHEMISTRY OF THE DECCAN TRAPS

FERMOR (1934) noted that there is some intrinsic difference in the chemical composition of the Upper and Lower Deccan trap flows. This point has a greater implication than has been hitherto thought and further studies of the chemical analyses of the Deccan traps have proved that on the whole the traps of the areas like Bombay, Poona and Cutch are higher in  $\text{SiO}_2$ ,  $\text{Al}_2\text{O}_3$ ,  $\text{Na}_2\text{O}$ , and  $\text{K}_2\text{O}$  and lower in  $\text{CaO}$ ,  $\text{FeO}$ ,  $\text{Fe}_2\text{O}_3$ ,  $\text{MgO}$  and  $\text{TiO}_2$  than those of Satpuras, Nasik, Neemuch and Rajahmundry.

To appraise the whole situation statistically the factor of Differentiation Index (Summation of normative quartz, orthoclase, albite, nepheline, leucite and kaliophillite) as proposed by Thornton and Tuttle may be chosen. It is seen that if some areas are excluded the values in normal traps lie in between 25 and 45. The areas excluded are such as Mt. Girnar, Pavagad, etc., which show highly differentiated rocks. By the study of the Differentiation Index variation diagrams it is noted that the intermediate rocks do not figure in. The curves when examined in between the two values of 25 and 45 do not show any trend of enrichment of  $\text{SiO}_2$  so as to produce the acidic rocks. It is unfair to prolong the curves to felsic end, especially when intermediate rocks are absent. It is suggested that the normal traps and the highly differentiated rocks as at Pavagad and Girnar belong to two separate magma entities.

After excluding the differentiated rocks of Western India, the basalt of the remaining Deccan trap province are for all practical purposes uniform in composition. It is here the D.I. values serve to pronounce the small chemical variation and differentiate in between two divisions of the basalt. The first or the Lower Division has the D.I. values around 29 and the second or the Upper Division has the values

around 39. Most of the analyses of normal traps examined tend to cluster around these two values. There is no sharp dividing line but it appears that as one proceeds towards west higher values of D.I. are encountered.

It is further noticed that these two divisions of Upper and Lower roughly correlate with the stratigraphical divisions of W. T. Blanford. The Upper Division traps are found in Western India in places like Bombay, Poona and Kathiawar and Cutch and Lower Division traps in the middle and eastern regions like those of Neemuch, Nasik and Satpuras. This implies that the earliest erupted flows were more basic (in restricted sense) in nature. The two analyses represent the two divisions (Table I).

TABLE I

	* Upper Division Traps (Bombay)	† Lower Division Traps (Linga)
$\text{SiO}_2$	.. 52.98	49.28
$\text{Al}_2\text{O}_3$	.. 14.53	11.69
$\text{Fe}_2\text{O}_3$	.. 3.38	3.04
$\text{FeO}$	.. 10.05	11.56
$\text{MnO}$	.. 0.02	0.23
$\text{MgO}$	.. 3.66	4.96
$\text{CaO}$	.. 7.49	10.49
$\text{Na}_2\text{O}$	.. 3.43	2.51
$\text{K}_2\text{O}$	.. 1.34	0.68
$\text{H}_2\text{O}$	.. 1.88	1.50
$\text{H}_2\text{O}$	.. 0.43	0.83
$\text{TiO}_2$	.. 0.63	3.23
$\text{P}_2\text{O}_5$	.. 0.64	0.31
D.I.	.. 41.64	28.36

\* Sukheswala and Poldervaart, 1958, p. 1480.

† Fermor, 1934, p. 350. Average.

This small differentiation noted in the two divisions cannot be explained by gravitative settling of early formed minerals, for there is no noticeable difference in mineralogy. This may be termed "Intra-molecular differentiation" and can be explained by limited liquid immiscibility and/or by the segregation of basic molecules in the magma chamber.

Since the oxides  $\text{CaO}$ ,  $\text{MgO}$ ,  $\text{FeO}$ , and  $\text{Fe}_2\text{O}_3$  (Grigg's work as quoted by Bowen, 1928) show unmixing at higher silica concentrations  $\text{Na}_2\text{O}$ ,  $\text{K}_2\text{O}$  and  $\text{Al}_2\text{O}_3$  show complete miscibility with  $\text{SiO}_2$  in all concentrations it can be argued that in a certain concentration the former group will definitely have lower miscibility than the latter group of oxides and as such slight differentiation is possible.

Also, in a liquid magma chamber theoretically the basic molecules, having much lower ionic radii in a mixed solution should segregate in the basal part of the solution. Thus magma can

become stratified in a limited sense under the influence of gravity and perhaps aided by the unmixing referred to above. Then the layers will be available for tapping in a sequence in which the earliest eruption will be more basic than the later ones.

Much more planned petrochemical work is needed for the vast Deccan trap province and this work, done on the available chemical analyses, fully justifies this fact.

I thank Dr. S. C. Chatterjee, Professor of Geology, Vikram University, for his encouragement and for improvements in presentation.

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#### ON THE USAGE OF TRIPHENYL TETRAZOLIUM CHLORIDE FOR THE MEASUREMENT OF PLANKTON POPULATIONS

As the energy transformations at various levels in an ecological complex could be used as indices of productivity in the marine environment, emphasis has been shifted in recent years more towards such determinations than the conventional and laborious quantitative methods of estimation of plankton. Gaarder and Gran's method (1927)<sup>2</sup> and Steeman Nielsen's method (1952)<sup>5</sup> deserve special mention as they aim at studying the rate of photosynthesis—the principal energy transforming process. Based on the principle that these energy transformations involve both enzymatic oxidations and reductions in the biological system, Aleem (1955)<sup>1</sup> stated "that a measurement of the dehydrogenase activity of the living plankton cells, under certain conditions of temperature, should give an indication of the protoplasmic matter present at the time" and employed Triphenyl Tetrazolium Chloride (T.T.C.)—a redox dye—for measuring the plankton populations. The colourless T.T.C. added to a plankton suspension undergoes reduction due to the dehydrogenase activity of plankton and yields a red-coloured

formazan. The amount of formazan is estimated colorimetrically using a spectrophotometer or a colorimeter.

Recently we carried out a number of experiments with T.T.C. to measure the plankton populations off Lawson's Bay, Waltair. Four samples of surface sea-water were collected every time in 125 ml. pyrex bottles to which 2 ml. of 0.2% (W/v) T.T.C. (E. Merck) solution was added. Two of these bottles were masked completely to prevent any interaction of sunlight and incubated in an open earthenware trough at an average temperature of 30° C. along with the other light bottles as in Gran's technique. After an exposure of 6 hours the formazan produced was extracted with a few ml. of acetone and isoamyl alcohol and estimated colorimetrically using a Lumetron photoelectric colorimeter at 420, 490 and 520  $\mu$ . A few experiments were also carried out with 10 ml. plankton suspensions in evacuated Thunberg tubes (dark and light) and the concentration of formazan was estimated with Beckman spectrophotometer.

The data collected from these experiments showed that the reduction of T.T.C. to formazan took place only in the samples exposed to sunlight but never in the dark containers. This is contrary to the observation made by Aleem (1955) who observed "that reduction of T.T.C. takes place in the light and dark alike.....". Perur (1960)<sup>4</sup> also observed the formation of the insoluble carmine red triphenyl formazan when stored in dark at the end of 72 hours in experiments carried out to measure the dehydrogenase activity in plant leaf tissues.

Two explanations may be offered to account for the reduction of T.T.C. to formazan only when exposed to sunlight. Either the reduction is purely a photochemical process or it may be due to photosynthesis—a process solely dependent on light.

Experiments were also carried out with phytoplankton-free sea-water and boiled sea-water which were incubated as already described. In this series of experiments also it was found that reduction of T.T.C. to formazan proceeded only in the bottles exposed to light which conclusively prove that the reduction was purely a photochemical process.

In a detailed review, Nineham (1955)<sup>3</sup> discussed the role of light on tetrazolium salts and showed that "many if not, all tetrazolium salts are sensitive to light". Referring to T.T.C. in particular he states that "the action of ultraviolet, and to a lesser degree of ordinary, light on an aqueous solution of this compound produces two new products, (1) the corresponding

formazan which explains the development of a red colour and (2) the oxidation product Photo T.T.C.”.

We are thankful to Dr. Ch. Bheema Sankara Rao, Department of Chemistry, Andhra University, for his helpful suggestions. One of us (D. V. S.) gratefully acknowledges the award of a Junior Fellowship by the National Institute of Sciences of India, during the tenure of which the present work was carried out.

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#### GUANINE IN THE EXCRETA OF SCORPIONS AND CERTAIN OTHER ARACHNIDS

It is well known that most of the terrestrial arthropods excrete nitrogen predominantly in the form of uric acid.<sup>1</sup> However, unlike the insects, spiders (Arachnida) have been shown to excrete mainly guanine, more than 80% of the nitrogen excreted being in the form of guanine nitrogen.<sup>2</sup> It is therefore of interest, from the comparative physiological point of view, to investigate the situation in other terrestrial arachnids such as the scorpions (Scorpionida), *Thelyphonus* (Uropygidæ) and *Phrynychus* (Amblypygidæ).

Scorpions belonging to two different genera (*Heterometrus* and *Lycas*), and *Thelyphonus* and *Phrynychus* which are locally available, were collected in large numbers and kept in separate glass containers in the laboratory. They were fed regularly on small insects. The excreta were collected daily as scrapings from the containers. Several milligrams of dry excreta were thus collected and 10 mg. samples of such excreta were analysed at a time, using the spectrophotometric method described in detail by Schmidt *et al.*<sup>2</sup> All measurements were made in a Hilger UVISPEK spectrophotometer. Total nitrogen content of the same samples of excreta was determined by the microkjeldahl method.<sup>3</sup> The average results obtained, using excreta from several individual specimens, are tabulated in Table I.

It is noticed from the results of Table I that as in spiders, guanine forms the predominant

nitrogenous compound in the excreta of most of the terrestrial arachnids. In scorpions and *Thelyphonus* it happens to be the main nitrogenous excretory product while in *Phrynychus* (Amblypygidæ) it is only a small fraction of the total nitrogen excreted.

TABLE I

Animal used	Guanine N as % of total N in the excreta (%)
1 Scorpionida: <i>Heterometrus</i> ..	90.42
<i>Lycas</i> ..	71.1
2 Uropygidæ: <i>Thelyphonus</i> ..	69.52
3 Amblypygidæ: <i>Phrynychus</i> ..	33.5

The biochemical significance, from the evolutionary point of view, of the occurrence of guanine in this group of arthropods (*viz.*, Arachnida) is not yet clear.

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#### TUBULAR AND FOLDED TYPE OF OLFACTORY SACCULE IN MASTACEMBELIDAE

THE nasal organ of bony fishes comprises two parts: (i) the olfactory saccule or chamber which is always present and forms the essential part of the organ, and (ii) the nasal sac, which may or may not be present and forms a secondary diverticulum of the olfactory saccule.

The olfactory saccule,<sup>5</sup> or the olfactory chamber,<sup>2</sup> in bony fishes, opening externally by either two nostrils (anterior and posterior), or a single nostril, has a membranous wall which becomes folded into lamellæ. These lamellæ more usually lie at the bottom of the saccule and carry the olfactory cells. According to Grasse,<sup>5</sup> the lamellæ present a variety of disposition which have been classified into seven types such as *Syphonostomum*, radial, *Ammodites*, *Belone*, parallel, asteral or sagittal rayed, and the rosette.

It has been interesting to find that the olfactory saccule or chamber of *Mastacembelus* (*M. armatus* Cuv. & Val.<sup>3</sup>) and *Rhynchobdella aculeata* Jerdon<sup>3</sup> is unique when compared with the aforesaid seven types. It is in the form of a folded tube broadest behind and gradually narrowing towards the front where it becomes confluent with the tubular anterior nostril.<sup>1,4</sup> The epithelial wall of the olfactory saccule is made up of tall, columnar, ciliated cells and is raised into folds or lamellæ on all sides with an elongated central space or cavity. As far as the author is aware, such completely lamellated type of olfactory saccule has not been described in any other fish. The folds or lamellæ remain separated by connective tissue, blood vessels, nerve fibres, etc. The central space of the saccule communicates with the exterior by two openings—tubular anterior nostril and a posterior nostril—the latter being valved and situated just in front of the eye. The ciliated epithelial cells of the olfactory saccule help in the continuous flow of water-current inside it through the tubular anterior nostril and its passing out through the posterior nostril in a similar manner as described by Bateson.<sup>2</sup> The epithelial cells do not secrete mucus as in other fishes.

The olfactory saccule in the family Mastacembelidæ shows an advance over the Syphonostomum type<sup>5</sup> of olfactory chamber and may, therefore, find a place as a new type of olfactory saccule in the Grasse's scheme of classification. This type of saccule may be called the tubular and folded type of olfactory saccule.

The tubular olfactory saccule is bounded behind by the lateral ethmoid bone<sup>6</sup> which is pierced by a hole for the passage of the olfactory nerve. Laterally it is supported by the elongated preorbital or lacrymal bone and dorsally it is covered over by the elongated nasal bone. The olfactory saccule in these fishes is not lodged in a hollow of the lateral ethmoid as described by Burne<sup>2</sup> in the fishes examined by him. The posterior nostril is, however, bounded dorsally by the hind end of the nasal and the lower edge of the lateral ethmoid bones, and ventrally by the elongated preorbital or lacrymal bone. According to Burne,<sup>2</sup> the anterior nostril is very frequently, especially in the lower Teleostei, more or less tubular. The tube is well marked in Eels, some Silluroids, *Anableps*, and *Ophiocephalus*, but the tubular anterior nostril present in the family Mastacembelidæ is unique among fishes and seems to be an extreme case of adaptation due to their shallow water and muddy habitat.

Another interesting feature of the nasal organ of *Mastacembelus* and *Rhynchobdella* is the origin of a diverticulum from the bottom of the posterior part of the olfactory saccule which extends both forwards and backwards in the form of a suborbital nasal sac. The nasal sac is thin-walled and by means of its alternate dilatation and compression helps in the continuous flow of water-current through the olfactory chamber thus bathing the lamellæ projecting from all sides. It has also been noted in the living fish that the alternate dilatation and compression of the nasal sac is due largely to the respiratory water-current and the movement of the operculum—the latter actually synchronises with the movement of the flap-like valve which guards the opening of the posterior nostril.

Such an extensive suborbital nasal sac present in *Mastacembelus* and *Rhynchobdella* extending both forwards and backwards from the place of its connection with the olfactory saccule is not known in any other fish.

The author expresses his indebtedness to Professor D. S. Srivastava for his valuable help.

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#### ON THE OCCURRENCE OF AN INTERESTING ELEOTRID FISH (*PARIOGLOSSUS TAENIATUS* REGAN) IN INDIAN WATERS

DURING a shore collection trip along the coast of Ratnagiri (Maharashtra), we came across a beautifully coloured Eleotrid fish in one of the rock-pools near our research station. This fish appears to be common in the rock-pools of brackish-water regions along the Ratnagiri coast.

Reference to literature on Eleotrid fishes of India<sup>1</sup> showed that no such fish has been recorded from India. Dr. A. C. Wheeler of the British Museum, London, identified the fish as *Parioglossus taeniatus* Regan. The Zoological Survey of India confirmed that no species of *Parioglossus* had been previously recorded

from Indian waters and, therefore, this may be taken to be the first record.

The genus *Parioglossus* is represented in the world by three species, *P. taeniatus* Regan<sup>1</sup> from Seychelle Islands, the Australian *P. rainfordi* McCulloch<sup>3</sup> from Queensland, and *P. borneensis* Koumans<sup>2</sup> from Balikpapan Bay, Borneo (Personal communication from Dr. A. C. Wheeler).

The general colouration of *P. taeniatus* from Ratnagiri is greenish-yellow, with a fairly thick dark longitudinal band on the side, extending from the post-opercular region to the caudal peduncle, where it ends in a black, roughly triangular patch edged with green lustre on its upper margin, nearly one-third in the caudal fin. Along this mid-lateral band in the upper margin of the belly region, there is a diffused streak of orange-yellow with a green sheen between the two. Slightly posterior to the pectorals, three rounded patches of brilliant violet-blue are arranged in a line, extending up to the fourth fin-ray of the first dorsal. Minute melanophores are arranged in a longitudinal pattern along the mid-dorsal line extending from the level of the eyes up to the peduncle. All the fins are almost transparent. There is an oblique iridescent band from the middle of the post-opercular bone, below the lower margin of the eye, to nearly the gape of the mouth. There are two such coloured patches but smaller in size, one on the lower margin of the post-opercle and the other on the peduncle of the pectoral fin.

We are thankful to Dr. A. C. Wheeler for the identification of the fish and to Dr. C. V. Kulkarni, Director of Fisheries, Maharashtra, for valuable suggestions.

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#### INCIDENCE OF MARINE WOOD-BORING MOLLUSCS ON THE SOUTH-EAST COAST OF INDIA

THE shipworms of the family Teredinidae are widely distributed along the coasts of India.<sup>1-4</sup> These pests are economically very important since they attack and destroy a variety of wood materials in the sea and brackish waters ranging from living mangroves<sup>5</sup> to even the floating seeds.<sup>1</sup> While the shipworms of Bombay,<sup>6</sup>

Madras<sup>1-3</sup> and Visakhapatnam<sup>4</sup> have been studied in considerable detail our information regarding the occurrence and distribution of these pests along the extensive coasts of India is incomplete. This is particularly so with regard to the south-east coast and near about the Krusadai Island, a locality visited by a large number of zoologists every year. The fauna of Krusadai<sup>7</sup> does not include any shipworm. A collection of wood-boring molluscs made on the last week of December 1961 from Pamban on the Rameswaram Island revealed the presence of at least nine species of shipworms and one wood-boring Pholad, *Martesia striata*. These borers were recovered from drift wood (*Cedrela toona*, *Tectona grandis*, *Thespesia*?, *Pandanus* sp.) that were cast ashore and in many cases only the shells and pallets were present the body having undergone degeneration. It is not clear whether these are permanent residents of this area or whether they are driven by the monsoon winds and cast ashore from neighbouring areas through the agency of the drift wood. The forms collected were *Bankia* (*Bankia*) *bipalmulata* (Lamarck), *Bankia* (*Bankiella*) *nordi* Moll, *Bankia* (*Bankiella*) *indica* Nair, *Bankia* (*Plumulella*) *lineata* Nair, *Teredo* (*Teredo*) *madrasensis* Nair, *Teredo* (*Nototeredo*) *nambudalaensis* Nair & Gurumani, *Teredo* (*Teredothyra*) *indomalaica* Roch, *Teredo* (*Lyrodus*) *malaccana* Roch and *Teredo* (*Dactyloteredo*) *diederichseni* Roch.\* The occurrence of these shipworms in Pamban extends the distribution of 8 species previously recorded either from other parts of Madras coast<sup>1-3,8</sup> or Visakhapatnam<sup>4</sup> to this area as well. For *Bankia* (*Bankiella*) *nordi* and *Teredo* (*Teredothyra*) *indomalaica* these are first records from India even though they have previously been reported from Indonesia and Singapore.<sup>9</sup> It is noteworthy that some of these shipworms show an extensive distribution in the Indian Ocean. Three species of the subgenus *Lyrodus* are known to occur in the Indian Ocean namely *Teredo* (*Lyrodus*) *affinis* Deshayes (Madagascar, East Africa), *Teredo* (*Lyrodus*) *malaccana* Roch (Malaya, Indonesia, Vizag) and *Teredo* (*Lyrodus*) *milleri* Dall, Bartsch & Rehder (Hawaii, Vizag). The occurrence of *Teredo* (*Lyrodus*) *malaccana* shows that this species too has an extensive distribution along the east coast of India. *Bankia* (*Bankia*) *bipalmulata* also shows a wide distribution having previously been recorded from Indonesia, Philippines, Hawaii, New Caledonia, New Hebrides, Pondicherry and Madras.<sup>9</sup> *Bankia* (*Plumulella*) *lineata* Nair<sup>3</sup> was first recorded from Madras and later reported as occurring from Vizag also.



It will certainly be worthwhile if an extensive survey is made of the underwater wooden structures along the south-east coast of India for a better understanding of the species which are well established forms in this area. This is an essential prerequisite for taking measures towards their control. A detailed report will be published elsewhere.

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Extension, Madurai,  
February 14, 1962.

\* Syn. *Teredo (Teredora) gregorei* Dall. Bartsch & Rehder (personal communication, Felix Roch).

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### CONTROL OF THE LISSORA FRUIT WEEVIL, *BARIS CORDIAE* MARSHALL (INSECTA: CURCULIONIDAE) IN RAJASTHAN

In continuation of the work on the control of *Baris cordiae* Marshall, reported by one of us (Kushwaha,<sup>1-3</sup>) further trials in respect of the control of this weevil were undertaken in 1960, using Endrin (EC., 0.025%), DDT (WP., 0.25%), BHC (WP., 0.25%) and Folidol (EC., 0.025%). Of these, only Endrin had given promising results that year. Consequently the control experiments during 1961 were restricted to Endrin only out of the above, but Ryania was also included as it had been reported effective against certain borers.<sup>4-6</sup> The present note gives an account of the recent trials conducted at different localities in Udaipur to work out an economic dose of Endrin in the control of this borer.

Endrin (20% EC.) was used as a spray in three concentrations, viz., 0.025%, 0.05% and 0.1%, while Ryania (90% WP.) was used as 1% spray. Applications were made as bloom sprays on three different dates—the first one during the last week of March and the second and the third during the first week of April. In all cases approximately only half of a tree was sprayed, the other half being left untreated

to serve as control. 200 fruits were collected at random 4 weeks after application in the case of each treatment for examination and the percentage of infestation recorded in fruit counts (vide Table 1).

TABLE I

Treatments	Percentage of infestation in fruit counts taken 4 weeks later			
	Trials made on 3 different dates in March-April			Mean results of the three trials
	I	II	III	
Endrin (0.025%) ..	2.5	..	..	0.83
Control ..	45	88.5	16.5	50
Endrin (0.05%) ..	..	..	1	0.3
Control ..	45.5	48.5	9	34.3
Endrin (0.1%) ..	2.5	2	..	1.5
Control ..	36.5	2	100	46.2
Ryania (0.1%) ..	0.5	52.5	94	49
Control ..	25	98.5	100	74.5

Means of results; Treatments: Control\* — 51.24; Ryania—49; Endrin (0.1%)—1.5; Endrin (0.25%) — 0.83; Endrin (0.05%)—0.3.

(\* Average of the means of the results of the controls of the three sets of Experiments.)

C.D. at 5% level of significance between control and treatments — 8.229.

Statistically, therefore, all doses of Endrin have given significant results over control, while in the case of Ryania the results have been insignificant.

Further, C.D. calculated at 5% level of significance between the different treatments works out at 10.28.

As such, the Endrin has provided significantly better control over Ryania, but the three different doses of Endrin are insignificant amongst themselves. It may be mentioned here that some fruits had shown tainting effect at the base of the fruit stalk in one of the treatments with 0.1% Endrin spray.

Our sincere thanks are due to Shri Y. Ramchandra Rao for going through the draft and Dr. A. Rathore, Principal, for laboratory facilities.

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# INHERITANCE OF GLUME PUBESCENCE IN *TRITICUM DICOCUM* SCHÜBL

In the course of breeding work in *Triticum dicocum* Schübl to evolve superior, rust-resistant strains suitable for cultivation in Peninsular India, carried out at the Wheat Breeding Substation, Wellington, a number of crosses were effected in which, incidentally, the inheritance of glume pubescence was studied. The data are presented in this note.

Kadam (1936)<sup>1</sup> found that the hairiness of glumes in Kala Khapli-568 is determined by the gene P which is dominant to p causing glabrous condition in *bansi* wheat. The gene P is completely linked with the black awn colour gene B.

Nine crosses were studied. The material was raised and studied during both the winter and summer seasons. The list of crosses studied and the pubescent and glabrous parents in each cross are indicated in Table I. In all the nine

noticed that the length of the hairs was variable and presumably the inheritance of the length and density of the hair may be polygenic.

The local *khapli* wheat cultivated throughout Peninsular India is pure for the glabrous condition. In improved rust-resistant strains of *khapli* wheat released for cultivation, it would be very difficult to do effective roguing at different stages, purely on the basis of slight differences, if any, in ear characteristics of the improved strain. It would also be difficult to do roguing in the improved strain on the basis of resistance to rusts only. A monofactorial character like glume pubescence would be very suitable for introduction as a marker into any improved rust-resistant *dicocum* to facilitate easy and effective roguing at the time of ear-emergence.

The author expresses his thanks to Dr. B. P. Pal, Dr. S. M. Sikka and Dr. A. B. Joshi for their interest in the work.

TABLE I  
Segregation of glume pubescence in the F<sub>2</sub> generation

Sl. No.	Year of study	Cross	Observed		Total	X <sub>(1)</sub> <sup>2</sup> for 3:1 ratio	P Value
			Pubescent	Glabrous			
1	Kharif 1956 ..	(I.C. 1131 × Local)	248	67	315	2.3375	.20 to .10
2	" ..	Pubescent (I.C. 1131 × I.C. 1132)	386	111	497	1.8839	.20 to .10
3	" ..	Glabrous P.D. 13 × I.C. 1131	393	149	542	1.7933	.20 to .10
4	" ..	Pubescent I.C. 1131 × P.D. 14	436	146	582	0.0023	.98 to .95
5	Rabi 1956-57	Glabrous I.C. 1703 × I.C. 1131	483	151	634	0.4732	.50 to .30
6	Kharif 1957 ..	Pubescent I.C. 1131 × I.C. 834	396	155	551	2.8777	.10 to .05
7	" 1959 ..	Glabrous H. 1-6-6-5-5-1 × E. 2774	121	48	169	1.0432	.30 to .20
8	Rabi 1959-60	Pubescent H. 1-6-315-15-32-3-2 × H. 39-3-20-774-1	776	233	999	1.4979	.30 to .20
9	" ..	Glabrous H. 39-4-11-412-1 × H. 1-6-315-15-32-3-2	52	22	74	0.8829	.50 to .30
						X <sub>(8)</sub> <sup>2</sup> for homogeneity 12.7892	.20-10
10	Kharif 1956 ..	(I.C. 1131 × Local) F <sub>1</sub> × Local	11	11	22	Nil X <sub>(1)</sub> <sup>2</sup> for (1:1 ratio)	1.0

crosses, pubescence of the glumes was dominant in the F<sub>1</sub>. The data of 9 F<sub>2</sub> segregates together with their statistics are presented in the same table. Only one back-cross was effected for which data are presented in Table I. F<sub>3</sub> data available in some of the crosses, clearly confirm the F<sub>2</sub> findings.

From the data presented in Table I it is clear that pubescence of the glumes is controlled primarily by a single factor. It was, however,

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## TWO NEW LEAF SPOT DISEASES OF *NEPHELIUM LITCHI* CAMB.

THE author has isolated three pathogenic fungi causing leaf spot diseases of *Nephelium litchi* Camb., namely *Pestalotia pauciseta* Sacc.,<sup>1</sup> *Botryodiplodia theobromae* Pat. and *Colletotrichum glaucosporioides* Penz. (the last named two organisms are reported as causal organisms of leaf spot diseases of *Nephelium litchi* Camb. here for the first time). Pathogenicity of the isolates has been established by inoculating the host leaves with spore inoculum produced in culture from isolations made from diseased leaves of *Nephelium litchi* Camb. In nature the infection is a mixed one being caused by either all the three organisms or more commonly by only the last two organisms, namely *Botryodiplodia theobromae* Pat. and *Colletotrichum glaucosporioides* Penz. although occurrence of separate spots caused by only one of the pathogens is less common. Infected portions of the leaf may fall off leaving behind punctures on the lamina. The midrib is often traversed by the advancing lesions on the leaf. In severe cases of infection majority of the leaves get diseased and this adversely affects fruit yield.

### I. LEAF SPOT DISEASE OF *Nephelium litchi* CAMB. CAUSED BY *Botryodiplodia theobromae* PAT.

**Symptoms.**—The spots usually start from the tip or the margin of the lamina. These spots are deep chocolate in colour. The limiting margins of the spots with irregular outline are vandyke brown. Black pycnidia appear on both the surfaces of the leaves but more often on the upper one.

**Causal organism.**—The pycnidia bear one-celled (two-celled at maturity) oval to ellipsoidal chestnut brown conidia ( $20.96-27.51 \mu \times 10.48-14.41 \mu$ ) which possess a thick wall of two layers and a granular matter inside. The hyphae are chestnut brown in colour, well branched and are provided with septa at very short intervals. At one side of the septum the hyphal end is swollen and on the other side it is tapering. The hyphae are  $2.62-5.24 \mu$  broad.

### II. LEAF SPOT DISEASE OF *Nephelium litchi* CAMB. CAUSED BY *Colletotrichum* *glaucosporioides* PENZ.

**Symptoms.**—The spots usually start from the tip of the lamina and extend towards the base. These spots are irregular in outline and are buckthorn brown in colour with a prominent mars brown margin encircling them. Mummy brown waxy sub-epidermal acervuli appear

on both the surfaces of the infected leaves but especially so on the upper one.

**Causal organism.**—The acervuli are provided with deep brown multicellular setae having a swollen basal cell. Cylindrical and oblong one-celled strawberry pink conidia ( $12.28-18.42 \mu \times 3.93-6.14 \mu$ ) with granular contents are produced in very large numbers on simple conidiophores ( $17.68-24.60 \mu \times 3.45-6.00 \mu$ ). The hyphae are white in colour. They are branched and septate and are  $1.31-2.62 \mu$  broad.

The author expresses his grateful thanks to Dr. R. N. Tandon, of the Allahabad University, and Dr. J. C. F. Hopkins, Director, and Mr. Sutton, Asst. Mycologist of the Commonwealth Mycological Institute, Kew, for suggestions and identification of the organisms under investigation.

Botanical Laboratory, S. S. PRASAD,  
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## STUDIES ON THE FACTORS INFLUENCING THE YIELD OF FIBRE IN JUTE

THIS investigation was undertaken with a view to have a critical evaluation of the three factors, namely, the height of the stem (plant height), the basal diameter, and the fibre: wood ratio of the stem, which influence the yield of fibre in jute. The materials used consisted of the two varieties of tossa jute (*Corchorus olitorius* L.), known as JRO-632 and C.G.

A microplot trial in randomized block design with 14 replications was laid out for this purpose; the blocks  $10' \times 8'$  each were arranged in two ranks with a path 3' wide between the ranks. The gross plot was  $10' \times 4'$  and the effective plot was  $8' \times 2'$  after leaving a non-experimental border of one foot all round. After usual pre-sowing operations the trial was sown in lines on the 2nd June 1961, with the help of a seed drill. Post-sowing intercultural operations including weeding, thinning, wheel-hoeing, top-dressing with ammonium sulphate (at 100 lb./acre) were given as usual.

A random sampling of 140 plants of each variety at 10 plants per effective plot was made on two occasions. (1) 105 days after sowing when the early variety C.G. was in the small pod or usual harvesting stage and (2) 119 days after sowing when the late variety JRO-632 was in the small pod stage. The height and the

basal diameter of the stem of the individual plants were measured just after sampling. The stems were then retted and the fibre and the wood or stick obtained from each stem were dried and weighed. The fibre wood ratio of each stem was then calculated. The data were subjected to analysis of variance.<sup>1</sup> The results are shown in Table I.

TABLE I

Variety	Stem or plant height (Mean in inches/stem)		Basal diameter (Mean in cm./stem)		Fibre : wood ratio (Mean/stem)		Fibre yield (Mean in gm./stem)			
	105 days after sowing	119 days after sowing	105 days after sowing	119 days after sowing	105 days after sowing	119 days after sowing	105 days after sowing	% over C. G.	119 days after sowing	% over C. G.
JRO-632	120.14	120.20	1.31	1.32	0.60	0.57	10.78	21.7	12.10	20.5
C. G.	102.20	102.90	1.22	1.26	0.46	0.45	8.86	..	10.04	..
	C.D. (1%)	C.D. (1%)	..	..	C.D. (1%)	C.D. (1%)	C.D. (5%)	..	C.D. (5%)	..
	10.80	7.43	..	..	0.025	0.021	1.40	..	1.75	..
	S.E. %									
	2.27	1.56	2.58	3.22	1.14	0.91	4.60	..	5.16	..

It will be seen that on either occasion, i.e., whether harvested 105 or 119 days after sowing, JRO-632 has proved significantly superior to C.G. in the mean stem or plant height and the mean fibre : wood ratio of the stem, while the small numerical difference in the mean basal diameter is not significant. Further the mean yield (per plant) of JRO-632 is significantly superior to that of C.G. at both the harvests which lends support to the previous findings with regard to the yield performance of these two varieties in large plot trials.<sup>1</sup>

Plant height and basal diameter of the stem have been used so long as the chief criteria for selection in jute breeding since these two characters have high positive correlation with yield of fibre.<sup>2,3</sup> Present results show that fibre : wood ratio can be used as a third criterion for selection in jute breeding. It is quite feasible to make use of this criterion, by the technique of random sampling, during the early stages of breeding.

My sincere thanks are due to Dr. K. T. Jacob, Director, and to Sri. B. Das Gupta, Botanist, for their interest in this work and the facilities afforded.

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#### DEVELOPMENT OF ABNORMAL AERIAL MYCELIUM OF THE MAIZE DOWNY MILDEW FUNGUS (*SCLEROSPORA PHILIPPINENSIS* WESTON)

THE genus *Sclerospora* Schroet belongs to the family Peronosporaceæ of the class Phycomycetes and is a serious parasite on several cereals and grasses. The vegetative mycelium and sex-organs of this fungus are developed within the intercellular spaces of the host tissues while only the sporangiophores are formed outside the infected plants. Sporangio-phores arise in groups of 3 to 4 through the stomatal apertures on leaves. Recently (1961) the writers observed abnormal development of aerial mycelium of this fungus on the leaves of maize seedlings when inoculated with the sporangia of *Sclerospora philippinensis* Weston parasitizing the Kans (*Saccharum spontaneum* L.) grass. After inoculation, the seedlings were placed for 48 hours in humidity chambers made by inverting glass cases over water in flat iron trays and the seedlings were later removed to a shaded corner in the laboratory. A few of the seedlings were, however, left over inside the moist chambers to study the effect of prolonged humidity on sporulation. After 7 days, a downy white growth consisting of well-developed aerial mycelium of the fungus was noticed on the surface of the leaves of seedlings left over in the moist chambers. The mycelium arose from aerial hyphæ that emerged

1. Annual Reports of the Jute Agricultural Research Institute, Barrackpore, West Bengal, 1952-54, 1956-58 and 1960.

out of the stomatal openings (Fig. 1). Exposure to excess of humidity for a long time seems to induce this condition.

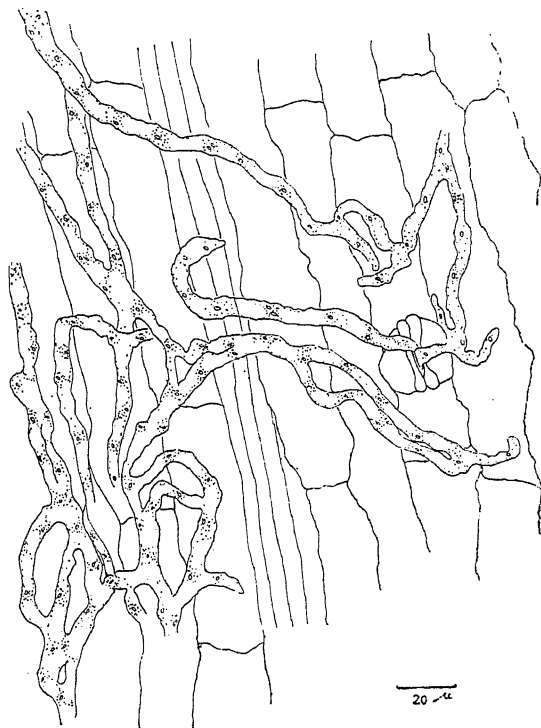


FIG. 1. Copious well-branched hyphae of the maize downy mildew fungus emerging out of the stoma of the leaf of the infected maize plant.

Similar development of abnormal aerial mycelium in place of normal sporangiophores under excessively humid weather was also observed in the case of *Sclerospora graminicola* (Sacc.) Schroet., the causal organism of green-ear disease of bajra (*Pennisetum typhoides*, Stapf and Hubb.) by the senior author near Agra (1959) (Fig. 2). Excessive humidity necessary was the result of prolonged rains in this case.

Development of such external mycelium was also noticed earlier by Suryanarayana and Chona (1960) on the leaves of *Setaria verticillata* Beauv. infected by *Sclerospora graminicola* (Sacc.) Schroet. when exposed to high humidity obtained by enclosing the infected branches of this grass in cellophane bags for 72 hours. The development of aerial mycelium occasionally from the sporangiophore initials observed in the last case indicates that it might be the modified sporangiophore phase.

The writers are indebted to Dr. R. S. Vasudeva, Head of the Division of Mycology and Plant



FIG. 2. Irregular, much-convoluted hyphal growth of the fungus *Sclerospora graminicola* on bajra leaves,  $\times 130$ . (The preparation is stained with Haematoxylin.)

Pathology, for offering us facilities and showing keen interest in this investigation.

Division of Mycology and D. SURYANARAYANA.

Plant Pathology, RAM NATH.

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#### PATH OF BUNDLES IN THE STEM OF *BOUGAINVILLEA*

THE anatomy of *Bougainvillea glabra* and *B. spectabilis* has been investigated. A preliminary account of these observations is given below; a detailed paper will be published elsewhere.

The internode in *Bougainvillea* shows an inner ring of vascular bundles in which leaf traces of one or more succeeding leaves are more or less deflected towards the periphery. The inner ring strands are surrounded by some-

what irregularly arranged intermediate bundles and these in turn are enclosed in a continuous cylinder formed by conjunctive tissue and a peripheral ring of vascular bundles. However, below the stem apex is seen only a single ring of procambial strands which later matures into the inner ring of bundles although by that time the intermediate strands and the peripheral ring of bundles may also become differentiated.

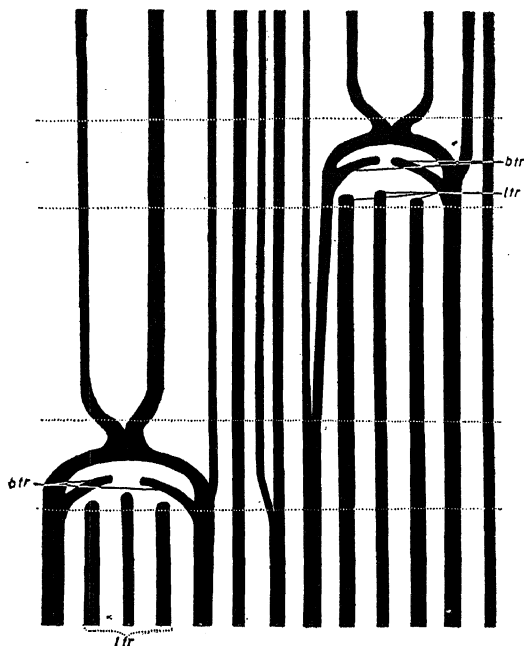


FIG. 1. *Bougainvillea* diagrammatic reconstruction of the longitudinal course of vascular bundles in the inner ring of the stem as flattened out in one plane. The accessory branch traces, intermediate bundles and the peripheral ring bundles are not shown to avoid complication. The length and thickness of the bundles is by no means proportional to their actual dimensions. Dotted lines indicate the approximate boundaries between nodes and internodes. *btr*, branch traces; *lir*, leaf traces.

The nodes of *Bougainvillea*, like those of other Nyctaginaceae which we have described previously,<sup>1-3</sup> are unilacunar. However, each adult node of *Bougainvillea* shows the departure of the traces to a single leaf and its associated axillary and accessory branches (pairs of leaves, leaf traces, etc., may appear almost opposite near apex but even here they are always at an angle of less than 180°) while in *B. diffusa* and *M. jalapa* even the nodes in the adult stem exhibit the departure of the traces to the two opposite leaves and their associated buds at about the same level.

The leaves of *Bougainvillea* are invariably supplied by three strands of the inner ring.

As they pass out the two lateral leaf traces get strengthened by fusions with intermediate and peripheral ring bundles which may later divide into smaller strands but the median trace enters the petiole as such. The three leaf traces thus enter the petiole without getting connected with one another.

The two strands of the inner ring lying adjacent to the two lateral inner leaf traces may enlarge in the node and form connections with the intermediate strands lying near them and then give rise to one small bundle each, which in its later course supplies the axillary and abaxial accessory branches (each node may show a spine which is the axillary branch and one to many abaxial accessory branches). After giving rise to the branch traces these strands fuse and divide (see Fig. 1).

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January 12, 1962.

D. DARSHAN PANT.  
BHARATI MEHRA.

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## TWO UNDESCRIBED SPECIES OF *ALTERNARIA*

An account of two new species of *Alternaria* collected during the tours, undertaken in connection with Crop Disease Survey of the State of Rajasthan, is presented here.

### *Alternaria* on *Rumex* sp.

In early stages, the infection appeared as yellowish-green necrotic areas, which later turned dirty brown and enlarged, causing circular to irregular spots (1-5 cm.). Sometimes the spots coalesced and heavily infected leaves shrivelled and dried up.

Fruiting amphigenous; conidiophores borne singly or in fascicles with stromata, brown, septate (0-5 septa, average 3), erect, unbranched, without geniculations, scars representing points of attachment present towards tips of the conidiophores; conidia catenate, 19-84 × 7-14 (average 49 × 10.5) μ, yellowish-brown, fusoid to obclavate, with 0-10 transverse septa (average 4) and 0-4 longitudinal septa, with smooth epispore, tapering gradually towards the apex which may be drawn out into a beak measuring up to 49 (average 10.5) μ with rounded ends.

Since the pathogen has some common characters with *A. ricini* (Yoshii) Hansford,<sup>2-4</sup> and *A. zinniae* Pape<sup>1</sup> (Table I) cross-inoculations

TABLE I

Comparison of the morphological characters of *A. rumicicola* with those of *A. ricini* and *A. zinniae*

Authority	Organism	Measurement of conidia in $\mu$		
		Width	Length	Beak
Stevenson, 1944 ..	<i>A. ricini</i>	15-29	47-96	51-200
Singh, 1955 ..	do.	12.6-33.6	29.4 - 92.4	42-100
Pawar and Patel, 1957 ..	do.	18.9-38	49.45- 85.5	32.5-195.7
Agarwal and Bhawe, 1959	<i>A. zinniae</i>	6.5-23	33-170.5	16-105
Authors ..	<i>A. rumicicola</i>	7-14	19-84	49

on *Ricinus communis* L. and *Zinnia* sp. were made. The conidia directly removed from the infected leaves of *Rumex* sp. were spread on plain agar in petri dishes and a single germinating conidium was transferred to a potato dextrose agar tube. In culture the young hyphae were hyaline, septate and irregularly branched, the colour of the colony changing from white to deep olive grey with age. Inoculations were made with a 10-day-old culture. Typical brown, circular to irregular spots appeared within 5 days on the leaves of inoculated plants of *Rumex* sp. only; fruiting on these spots being observed on the seventh day. On reisolation a typical culture of the fungus was obtained.

On the basis of the morphological characters (smaller size of conidia) and specialised parasitism, a new species is proposed.

*Alternaria rumicicola* sp. nov. (FIG. 1)

Fructificationes amphigenae; conidiophori singuli vel fasciculati simul cum stromatibus, brunnei, septati (septis 0-5, vulgo 3), erecti, non-furcati, geniculationibus nullis, cicatrice monstrante punctum unionis praesente ad apices conidiophorum; conidia luteolo-brunnea, fusioidea vel obclavata, septis transversis 0-10, vulgo 4, et longitudinalibus 0-4 ornata, magnit.  $19.84 \times 7.14$  (mediet  $49 \times 10.5$ )  $\mu$ , episporio levi, catenata, gradatione fastigata ad apicem, qui produci potest in rostrum septatum usque ad 49 longum (vulgo  $10.5$ )  $\mu$ , apicibus rotandatis.

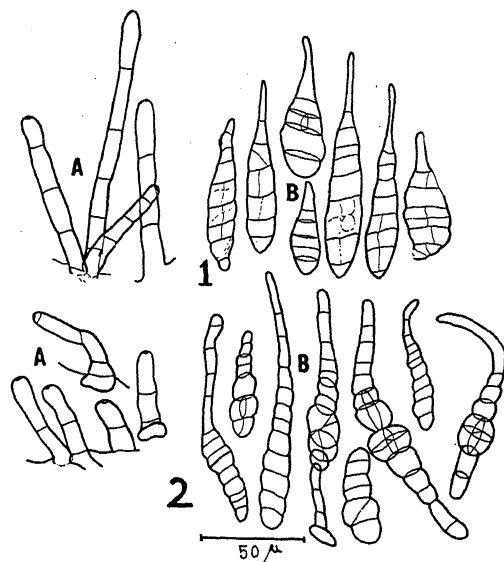
In foliis viventibus *Rumicis* sp. mense januario anni 1961 in Sajjan Niwas Garden, Udaipur in Rajasthan, leg. R.N.S.T. & J.P.A. Typus positus in R.P.P.H. Udaipur (432) et cotype in C.M.I. in Anglia (86480).

*Alternaria* sp. on *Limnanthemum indicum* THW.

Spots pale brown, circular to irregular with concentric rings, measuring 1-5 cm.; fruiting epiphyllous; conidiophores simple, borne singly or in fascicles of 2-3, light brown, erect or slightly curved, the upper cells pale, bearing catenate conidia on blunt tips which have prominent

scars, 0-4 septate (average 3), measuring  $21.96 \times 4.5$ - $10.5$  (average  $29.75 \times 7$ )  $\mu$ ; conidia dark brown, ventricose to ventricose rostrate, sometimes with large rounded cells in the middle which have prominently transverse and longitudinal septa, with 3-13 transverse (average 3) and 0-4 longitudinal septa, measuring  $28.94.5 \times 7.14$  (average  $51.75 \times 10.5$ )  $\mu$  with beaks which measure up to 52  $\mu$  or no beaks.

Hitherto there has been no record of *Alternaria* sp. on *Limnanthemum* sp. and the shape and size of the conidia and conidiophores differ from *Alternaria* spp. so far recorded. The fungus is, therefore, described as a new species.



FIGS. 1-2. Fig. 1. *A. rumicicola*. A—conidiophores; B—conidia. Fig. 2. *A. limnanthemicola*, A—conidiophores; B—conidia.

*Alternaria limnanthemicola* sp. nov. (FIG. 2.)

Fructificationes epiphyllae; conidiophori simplices, singuli vel fasciculati bini vel terni, pallide brunnei, erecti vel paulum curvati, cellulis superioribus pallidioribus, supportantes conidia catenulata ad apices hebetes cicatricibus emi-

mentibus ornatos, 0-4 septati (vulgo ter), magnit.  $21-96 \times 4.5-10.5$  (mediet.  $29.75 \times 7$ )  $\mu$ ; conidia fusce brunnea, ventricosa vel ventricoso-rostrata, quorum plurima cellulas ad medium amplas rotundatosque monstrant, suntque eminenter septata transverse et longitudinaliter septis 0-4 transverse quidem septis 3-13 (med. 8) longitudinaliter vero 0-4 septis, magnit.  $28-94.5 \times 7-14$  (mediet.  $51.75 \times 10.5$ )  $\mu$ , rostris septatis ad  $52 \mu$  longis vel nullo rostro.

In foliis viventibus *Limnanthemi indici* Thw., die 26 martii anni 1961, Nakki Lake, Mt. Abu, in Rajasthan, leg. J.P.A., R.N.S.T. and S. Misra.

Typus positus in R.P.P.H. Udaipur (433) et cotype in C.M.I., in Anglia (86486).

Grateful thanks are due to Dr. M. B. Ellis and Miss G. M. Waterhouse (C.M.I., Kew, Surrey, U.K.) for suggestions and help in the identification of the fungi and for going through the manuscript respectively and to Fr. Dr. H. Santapau, Chief Botanist, Botanical Survey of India, for rendering the Latin diagnoses.

Plant Pathology Section, R. L. MATHUR.  
Department of Agriculture, J. P. AGNIHOTRI.  
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### TEA CLASSIFICATION REVISED

In recent years salient chemical and anatomical features of a "Southern form of tea" have been investigated at the Tocklai Experimental Station.<sup>1,2</sup> Closely imbricate orbicular sepals and several flowers on a common axillary peduncle are characteristic of the plants that were studied. On these grounds the "Southern form of tea" can be associated with Planchon's *Thea lasiocalyx*.

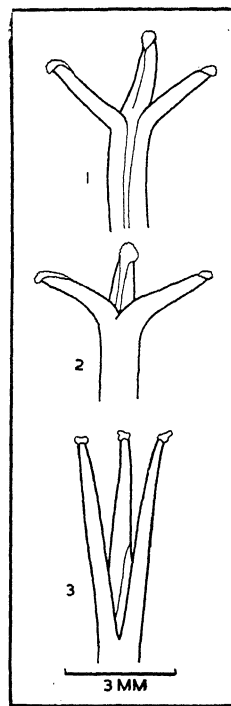
An account of *Thea lasiocalyx* was written by Watt<sup>3</sup> who agreed with Planchon that it is distinct from the species originally named *Thea sinensis* by Linnaeus. In his description of *T. lasiocalyx*, Watt mentioned external pubescence of the sepals, but this does not seem to be a feature of critical value.

Further discussion will be simplified by reference to the synonymy of *Thea* and *Camellia*. As the former genus has been merged in the latter genus, the original *Thea sinensis* L. is now written *Camellia sinensis* (L.). It should also be noted that Linnaeus founded the species on a

drawing published by Kaempfer<sup>4</sup> and not on an actual specimen. Thus the features shown by the drawing are of prime importance.

The Tocklai investigations included another type of tea, chemically<sup>1</sup> and anatomically<sup>2</sup> distinct from the "Southern form," with divaricate orbicular-triangular sepals, and flowers singly, or in pairs, or more rarely in fascicles, in the leaf axils. On these grounds it could be associated with Kaempfer's drawing and is therefore correctly named *Camellia sinensis* (L.). The Tocklai plants are regarded as typical of the species. They agree with R. Fortune's specimen No. 165 collected in China in 1845 (in Kew herb.).

Plants assignable to Masters' *Thea assamica*<sup>5</sup> were investigated and found to be chemically<sup>1</sup> and anatomically<sup>2</sup> distinct from *C. sinensis* (L.). Specific rank should be retained for *T. assamica*, and it is therefore named *Camellia assamica* (Masters).



FIGS. 1-3. Fig. 1. Styles of *Camellia sinensis* (L. free for the greater part of their length or to the base, geniculate. Fig. 2. Styles of *C. assamica* (Masters), united for the greater part of their length, the free part short, more or less horizontal. Fig. 3. Styles of *C. assamica* subsp. *lasiocalyx* (Planch. MS.), free for about half their length, linear, ascending.

The "Southern form of tea", now associated with the epithet *lasiocalyx*, is more closely



related to *C. assamica* than to *C. sinensis*. The "Southern form" should be treated as a subspecies of *C. assamica*, and it is therefore named *Camellia assamica* subsp. *lasiocalyx* (Planch. MS.).

This ranking of the taxa can be supported by further data awaiting publication. For example, Figs. 1-3 illustrate stigmas and style-arms typical of *C. sinensis*, *C. assamica*, and *C. assamica* subsp. *lasiocalyx*, respectively.

Tea estate surveys have demonstrated that many populations are undoubtedly hybrids between *C. assamica* and *C. sinensis* as defined. The surveys further demonstrated the essential point that truly intermediate plants are rare: there is generally a preponderance of features which bias a population towards one taxon or the other. But the distinctiveness of the taxa is obscured, and can be seen only in selected, true breeding, populations. For instance, in many cultivated populations a mixture of style types could be expected.

*Camellia assamica* subsp. *lasiocalyx* has not been cultivated in Assam, nor in Northern India generally. It is of value for breeding<sup>6</sup> but its thoughtless introduction could significantly, and perhaps adversely, alter the character, and particularly the liquor strength, of tea made in Assam.

It is the purpose of this note to propose, and give the main reasons for, new nomenclatural combinations arising from extensive studies that will take time to publish. They support Watt's earlier conclusions<sup>3</sup> regarding the distinctiveness of Planchon's *Thea lasiocalyx*, and do not support the 'lumping' (synonymy) of this taxon with *Camellia sinensis* (L.) var. *sinensis*, proposed by Sealy.<sup>7</sup>

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## JOHANNESBAPTISTIA PELLUCIDA FROM ANDHRA PRADESH

THE Cyanophycean alga *Johannesbaptistia pellucida* (Dickie) Taylor and Drouet was collected from a freshwater stream Kunderu, near the village Vedullapalli (Guntur District). The bed of the stream was extensively used for growing rice and was polluted occasionally with salt-water from the nearby (about 4 miles) sea.

The present form resembles closely the one collected from Ennore, near Madras.<sup>1,2</sup> The filaments are as long as 1,250  $\mu$  and 6-10  $\mu$  broad, individual cells 3.5-5.0  $\mu$  broad. The sheath of individual cells is more firm than the common sheath of the filament. However under the phase-contrast illumination both the sheaths can easily be differentiated with or without staining with dilute methylene-blue (Fig. 1 a).

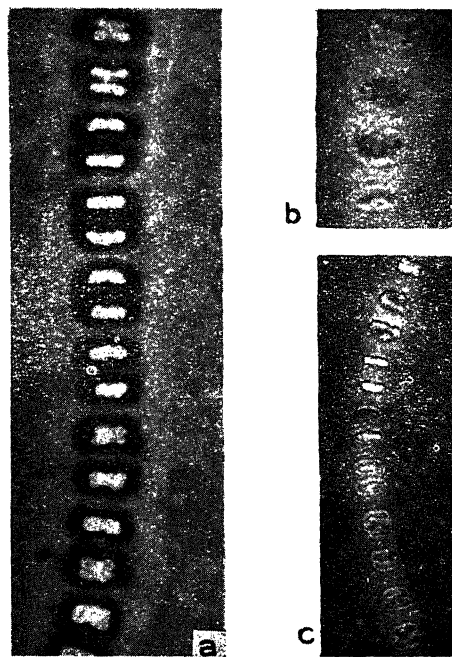


FIG. 1. a—Filament with staining, under phase-contrast illumination,  $\times 1,500$ ; b-c—Showing intercalary akinete-like bodies, b,  $\times 1,450$ , c,  $\times 800$ .

The main interest in the present form is the presence of paired, intercalary, thick-walled, kidney-shaped akinete-like bodies (Fig. 1, b & c). They generally show prominent and highly refractive granules. Although no stages of germination of such bodies was found in the material collected, they are considered to serve as akinetes of other blue-green algæ.

Thanks are due to the Head of the Department of Botany for the facilities, and to Dr. R. N. Singh for the encouragement and help. Department of Botany, E. R. S. TALPASAYI. Banaras Hindu University, Varanasi-5, January 15, 1962.

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### ON THE INTESTINAL CONTENTS OF TADPOLES AND ALGAE OF SMALL PONDS

FARLOW<sup>1</sup> after examining the intestinal contents of the tadpoles and the algæ of small ponds came to the conclusion that the intestinal contents of the tadpoles give a good idea of the algæ of small ponds. The author, while working on the algal flora of Kolhapur in the Maharashtra State, came across a large number of tadpoles in four small ponds. This opportunity was taken to find out how far Farlow's conclusion apply here. For this, nearly 200 tadpoles were collected from these four small ponds along with the algæ. Careful microscopic examination of the intestinal contents of these tadpoles showed mainly the species of *Spirogyra*, *Oscillatoria*, *Oedogonium*, *Hydrodictyon*, *Anabaena*, *Cosmarium*, *Closterium*, *Phacus*, *Euglena* and a large number of diatoms. It was, however, noteworthy that the intestinal contents did not show any trace of species of *Pithophora*, *Cladophora*, *Chara*, though these algæ were among the common algæ of these four ponds. It was thought desirable, therefore, to find out whether tadpoles feed on all available algæ or not.

For this purpose, tadpoles without any limbs were collected from these four ponds and were grown in the laboratory in glass jars. Two tadpoles were kept in each jar of 500 c.c. capacity. Triplicate sets were maintained for each algæ.

The different algæ in the vegetative condition, collected from the same ponds, tried were: (1) *Anabaena volzii* Lemm., (2) *Characiosiphon rivularis* Iyengar, (3) *Chara vulgaris* L., (4) *Cladophora callicoma* Kuetz., (5) *Cylindrospermum muscicola* Kuetz., (6) *Hydrodictyon reticulatum* (L.) Lagerh., (7) *Microchaete uberrima* Carter, (8) *Nostoc sphaericum* Vauch., (9) *N. spongiæforme* Ag., (10) *Oedogonium rugulosum* Nordst. ex Hirn, (11) *Pithophora oedogonia* (Mont.) Wittrock, (12) *Spirogyra liana* Transeau and (13) a mixture of *Cosmarium* spp., *Phacus* spp., *Euglena* sp. and diatoms.

The tadpoles were kept in the jars for four to five days, until their limbs appeared, under observation most of the time and later dissected to study intestinal contents.

It was found that tadpoles did not eat (1) *Chara vulgaris*, (2) *Cladophora callicoma*, (3) *Nostoc sphaericum* and (4) *Pithophora oedogonia* even when starved. The rest of the algæ were readily eaten. One each of these starved tadpoles when given *Spirogyra* sp., they readily ate. It is evident, therefore, that tadpoles do not feed on all available algæ and hence the data collected from the intestinal contents would be naturally incomplete with respect to those algæ.

The work was carried out at the Botany Department, Rajaram College, Kolhapur and the author takes this opportunity to thank Shri M. K. Dharmadhikari for the kind help.

Botany Department, N. D. KAMAT.  
Institute of Science,  
Bombay-1, February 17, 1962.

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### EXTRA-OVULAR OUTGROWTHS IN THE RUBIACEAE

BESIDES the usual integument or integuments which become transformed into the seed coat after fertilization, other outgrowths such as aril, caruncle, strophicle, etc., are known to develop associated with a number of angiospermous seeds. The aril has been interpreted as an additional integument and as a primitive character (Corner, 1949). The caruncle also is supposed to be a rudimentary aril. Since the discovery of the strophicle by Lloyd (1902) in *Diodia*, it has been reported in a number of rubiaceae taxa. The morphological nature of this structure and its function have remained a disputed problem. However, this outgrowth is also individually formed and discrete for each seed, just as the aril and caruncle are.

*Tarenna asiatica* (L.) Sant. & Merch. and *Randia malabarica* Lamk. of the Rubiaceae exhibit outgrowths which cannot be classified under any one of the above-mentioned categories. The inferior, bicarpellary and bilocular ovary of these taxa contains many hemianatropous, unitegmatic ovules arranged on axile placentæ. The tissue of the axile placentum, in early stages of development of ovules, becomes extended as common plates between the ovules. At the time of fertilization, the ovules themselves become 'embedded' in these placental outgrowths (Figs. 1, 2). In *Tarenna*, the placental extensions cease to grow

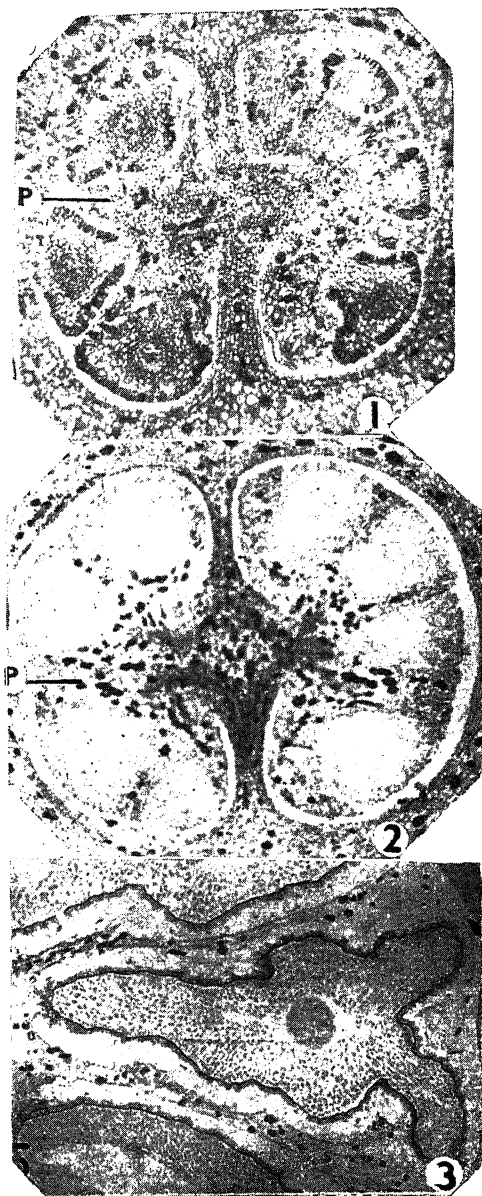
after fertilization and remain more or less in an arrested state (Fig. 1), whereas in *Randia* they continue to grow at the same rate as the

(Fig. 3). The tissue also gets involved in the phenomenon of rumination which occurs after fertilization in the seed proper (Periasamy, 1959). Finally, the entire tissue is turned into a pulpy mass in which the mature seed lies embedded (Fig. 3). Abundant tannin cells occur in the placental tissue of both the plants (Figs. 1-3).

Even though the placental outgrowths remind one of an integument or aril in *Randia* and that of a strophiole (in so far as it remains small and rudimentary) in *Tarenna*, the lack of individuality of these outgrowths for each seed obviates interpreting them morphologically as belonging to any one of the already mentioned categories. Even those outgrowths of the placenta which function as obturators (Maheshwari, 1950) are formed only in the proximity of the micropylar region, and are not known to grow further after fertilization. Therefore, the placental outgrowths of the rubiaceous taxa appear to be somewhat unique and their occurrence around the integumented ovules calls for a morphological and functional explanation in the light of other extra-ovular structures.

Department of Botany,  
Presidency College,  
Madras-5,  
February 14, 1962.

K. PERIASAMY.  
N. PARAMESWARAN.



FIGS. 1-3. Fig 1. *Tarenna asiatica*. T.s. of ovary just after fertilization,  $\times 70$ . Fig. 2. *Randia malabarica*. T.s. of ovary just after fertilization,  $\times 53$ . Fig. 3. *Randia malabarica*. Portion of a t.s. of mature fruit showing a single seed and placental tissue,  $\times 30$ . P = Placental tissue.

ovules and almost completely surround them except for a small opening at the free end

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### AN ADDITION TO THE INDIAN SPECIES OF *CORDYCEPS*

THE genus *Cordyceps* is represented in India by three species. *Cordyceps falcata* Berk. and *C. racemella* Berk. have been reported from Khasi Hills on dead caterpillars,<sup>1</sup> and *C. speciocephala* (Berk.) Sacc. from Agarpara near Calcutta on dead ants.<sup>5</sup>

During December 1961, the writer collected specimens of a *Cordyceps* on ants in a forest adjoining the Coffee Research Station, Balehonnur. The following description is derived from these specimens.

Stipe arising between head and thorax of the insect, single, slender, curved, light brown to black, 9-12 mm. long, 50-90  $\mu$  thick; perithecial cushions one to two in number, lateral, pulvinate, black, rough due to the projecting apical parts of the perithecia, 0.5 to 1 mm. in diam. and 0.6 mm. in height; perithecia ovoid to ellipsoid,

very closely aggregated, embedded in the stroma except for the apices,  $243-349 \times 89-6-$

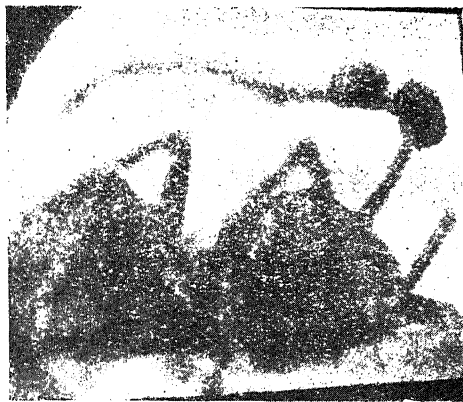


FIG. 1. *Cordyceps unilateralis*. Ant with stipe bearing lateral perithecial stroma.

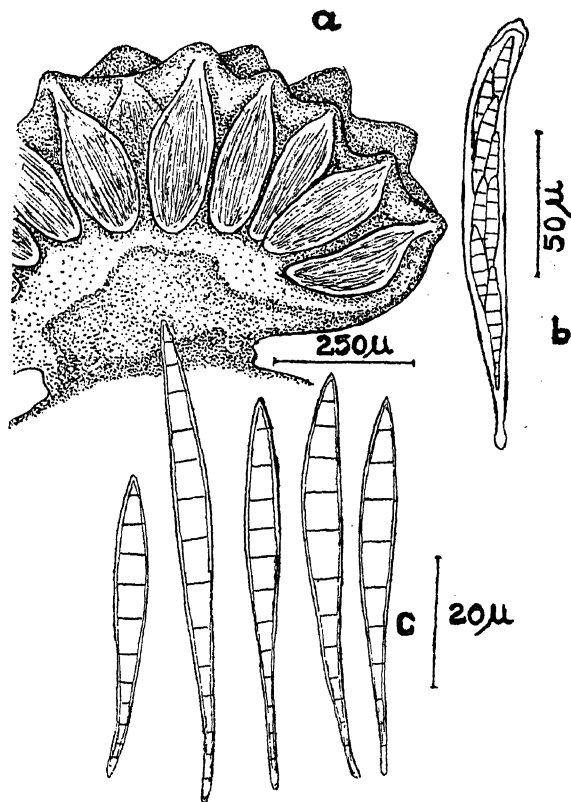


FIG. 2. (a) Portion of head showing embedded perithecia. (b) Ascus with overlapping ascospores. (c) Ascospores.

$112 \mu$ ; asci octosporous, clavate, thin-walled, hyaline, wall slightly thickened at the apex

into  $2-3 \mu$  thick caps,  $96-166 \times 6-11 \mu$ ; ascospores overlapping each other, narrowly fusoid, ends acute to acuminate, hyaline, multiseptate, not breaking into fragments at the septa,  $42-61 \times 3-4 \mu$  (Figs. 1 and 2).

On ants, Hymenoptera, Formicidae. Coffee Research Station, Balehonnur, India, December 25, 1961.

Apparently these collections are *Cordyceps unilateralis* (Tul.) Sacc. These are slightly at variance in the size of the asci and ascospores which are much shorter than the measurements given for the species by Mains.<sup>3</sup> Species with clavate asci and narrowly fusoid ascospores have been grouped under a separate genus *Ophiocordyceps* by Petch.<sup>4</sup> Later, Kobayasi<sup>2</sup> and others reduced the rank of *Ophiocordyceps* Petch to a subgenus under *Cordyceps*. Mains<sup>3</sup> restricts the subgenus to species with non-capitate clavate asci and narrowly fusoid ascospores.

This note records *Cordyceps unilateralis* for the first time in India. The specimens have been deposited at Herb. Crypt. Ind. Orient., Indian Agricultural Research Institute, New Delhi, under Accn. No. 27515.

The writer is grateful to Mr. K. V. George, Mycologist, for help and laboratory facilities and to Dr. N. G. Chokkanna, Director of Research, for permission to publish this note.

Coffee Research Station P.O., T. R. NAG RAJ.  
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January 20, 1962.

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#### POLLEN MORPHOLOGY OF *CALLICARPA LONGIFOLIA* LAMK. AND *CONGEA TOMENTOSA* ROXB.

THE present study of the pollen morphology of *Callicarpa longifolia* Lamk., and *Congea tomentosa* Roxb. is based on the polliniferous material collected from dry plant specimens (Jain, 13140, and Lancaster, 48141 respectively), deposited in the herbarium of National Botanic Gardens, Lucknow. Pollen preparations have been made by the aceolysis method,<sup>1</sup> and the terminology used in pollen descriptions is the same as used by Nair.<sup>2</sup>

# DESCRIPTION

## *Callicarpa longifolia* LAMK. (FIG. 1, a-d)

Pollen 3-zonicolporate,  $\pm$  spheroidal (diameter  $37\mu$ ; range  $32-40\mu$ ), with a circular amb. The ectocolpium (outer opening of colpus; Fig. 1, ec.)  $5.2\mu$  wide at the equator, tenuimarginate, its ends acute. The endoapertures (inner openings of the colpus, i.e., endocolpium; Fig. 1, en; syn. Ora<sup>1</sup>) formed as faint, narrow, elongate and irregular areas varying in number from 7-10 for each colpus. Exine  $2.8\mu$  thick, ectine being almost as thick as endine. Ectine surface granulate.

almost as thick as endine. Ectine ornamentation areolate.

Colporate sporomorphs with more than one endoapertures are a rarity among angiosperms. Two endoapertures on every colpus have been observed in species of *Didymelea* (Didymelaceae), *Breynia* (Euphorbiaceae), *Myoporum* and *Pholidia* (Myoporaceae), and *Capraria* (Scrophulariaceae), while 3-4 endoapertures have been observed in *Congea villosa*. In addition to the above, the present study has given evidence of the presence of more than one faintly delimited endoapertures in *Callicarpa*

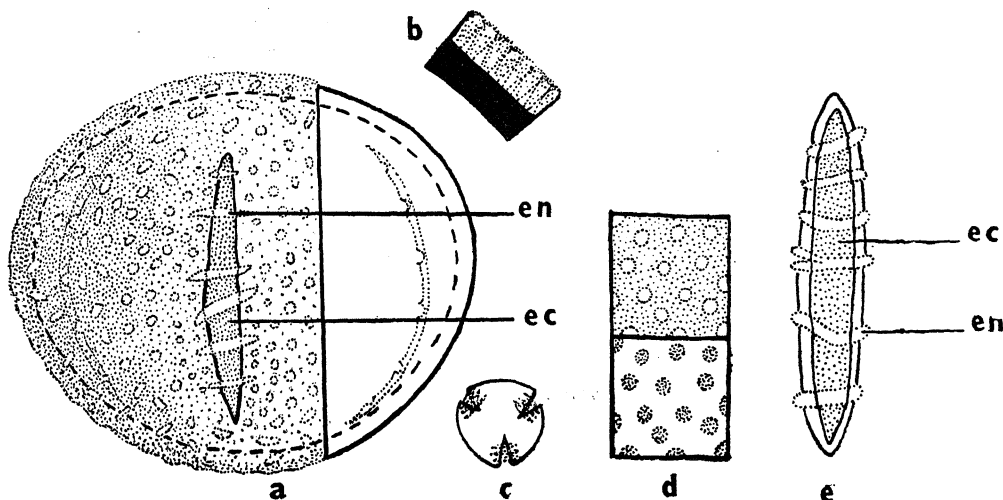


FIG. 1. a-d. Palynogram of *Callicarpa longifolia*: a. Main Fig. Equatorial view. General surface shown on one-third of the grain,  $\times 1,500$ ; b. Strata of exine,  $\times 3,000$ ; c. Polar view,  $\times 375$ ; d. OL showing granulation,  $\times 3,000$ ; e. Colporate aperture in *Congea tomentosa* (ec, ectocolpium; en, endoapertures),  $\times 1,500$ .

## *Congea tomentosa* ROXB. (FIG. 1, e)

Pollen 3-zonicolporate, subprolate ( $39 \times 31\mu$ ; range  $35-42 \times 28-32\mu$ ), with a circular amb. The ectocolpium  $4.2\mu$  wide at the equator, crassimarginate at intervals (Fig. 1e, ec), delimited by the margin of the endoapertures (Fig. 1e, ec), its ends acute. The endoapertures vary in number from 3-5, each being elongate ( $2.8 \times 9.8\mu$ ; range  $2.8 \times 4.8-5.6\mu$ ), with acute or pointed lateral ends (rarely bifurcate) with regular or irregular equatorial margins and oriented horizontally or at an angle with reference to the length of the ectocolpium. Exine  $2.1\mu$  thick, ectine being

*longifolia* and *Congea tomentosa*. This feature has not been observed in the pollen of any other species of *Callicarpa* so far.

The author is thankful to Professor K. N. Kaul, Director, for his encouragement and to Dr. P. K. K. Nair for guidance.

Palynology Laboratory, K. RAHMAN.  
National Botanic Gardens,  
Lucknow,  
February 19, 1962.

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REVIEWS

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**Concepts from Tensor Analysis and Differential Geometry.** Vol. I, *Mathematics in Science and Engineering Series*. By T. Y. Thomas. (Academic Press, New York and London), 1961. Pp. 1-115. Price \$ 5.00.

This is the first volume of the series of monographs and text-books on *Mathematics in Science and Engineering* edited by Richard Bellman. According to the Editor, many recent mathematical theories can be applied to a number of different scientific areas; many scientific areas of significance require a cross-section of mathematical theories for their successful treatment, and the purpose of this new series of monographs is to present the theory and application of these recent scientific and mathematical developments. This purpose is admirably served by the volume before us which is the first in this new series. The monograph is suitable not only to students of pure mathematics, but also to those students whose primary interest is the study of certain aspects of applied mathematics including the theory of relativity, fluid mechanics, elasticity, and plasticity.

There are altogether 25 sections developed within the compass of 115 pages containing a wealth of topics, and although this entails strict brevity in dealing with each topic, no sacrifice is made either in clarity of presentation or in the logical development of the subject. Nor do we find the omission of any really important areas of interest, specially from the point of view of applications, for, the choice of topics has been made taking this also into consideration.

The first five sections and Section 12 might be considered to constitute the basic foundation on which the subject is developed. These sections deal with several types of co-ordinate manifolds, notions of scalars, vectors, and tensors defined on these manifolds. The notion of groups of transformations is considered briefly in the first section and amplified in Section 12 to the important particular cases of the affine group, the orthogonal group, and the Euclidean group leading respectively to the affine space, the Euclidean metric space, and the Euclidean space with the corresponding affine geometry, Euclidean metric geometry, and Euclidean geometry imbedded in them.

A succinct account of Riemann spaces is given in Section 6, and the next five sections are

devoted to the generalisation of this to affinely connected spaces.

The remaining sections deal with classical differential geometry in a space of three dimensions, without rigidly adhering either to a Riemannian  $R_3$  or an Euclidean metric  $E_3$  only. Special mention may be made of Section 17 dealing with mixed surface and space tensors, co-ordinate extension and absolute extension wherein these topics, treated earlier for general affinely connected spaces, are explained in relation to a  $R_3$  and serve to clarify the tensorial significance of surfaces and curves in this space.

Another feature we notice in this monograph is that the treatment is not rigidly confined only to generalised  $n$ -dimensional spaces, and tensors of general orders, but special cases are considered wherever necessary for purposes of clarification. We have no hesitation in saying that this monograph admirably fulfils the purpose with which it has been prepared.

B. S. MADHAVARAO.

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**Discrete Variable Methods in Ordinary Differential Equations.** By Peter Henrici (John Wiley and Sons, Inc., New York and London), 1962. Pp. xi + 407. Price \$ 11.50.

Numerical Analysis is rapidly developing and playing an increasingly great part in Modern Mathematics. The book under review is concerned, as its title makes it clear, with particular methods of numerical approximations in Differential Equations. The solution of a differential equation of the form  $y' = f(x, y)$  with initial condition at  $x = a$  is discretely approximated when, within a certain margin of error, the values of  $y$  are obtained at a discrete set of points:  $x_0 = a, x_1, \dots, x_n$ . A first method, called one-step method, is concerned with finding the approximate value of  $y(x_i)$  knowing that of  $y(x_{i-1})$ . The second, called multi-step method, makes it possible to calculate  $y(x_i)$  when the values of  $y(x_j)$  are known for a number of values of  $j < i$ . The steps themselves call into play only elementary analysis. The most delicate part of the methods is however to obtain estimates of the errors made in applying them. One thinks naturally of resorting to classical analysis and obtaining certain inequalities. The result would be extremely rough estimates. It is therefore

necessary to consider the local round-off errors as random variables and apply general principles of statistics, a summary of which is given by the author. The most difficult, but the most useful, part of the book is that devoted to the statistical calculus of errors and the reviewer believes that it is the first time that such methods are explained in the form of a treatise.

The methods developed in the case of a simple equation can be extended to systems and differential equations of higher order. It is also possible to develop a method for an equation of the form  $y'' = f(x, y)$  when the value of  $y$  is given at the extremities of the interval of variation of  $x$ .

In addition to results due to several Mathematicians, the book contains some original contributions due to the author. A rich set of exercises and problems enhances considerably the value of this text. The get-up is naturally excellent as this is a John Wiley and Sons book.

C. RACINE.

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**Cybernetics**, 2nd Edition. By Norbert Wiener. (The M.I.T. Press and John Wiley & Sons, Inc., New York), 1961. Pp. xvi + 212. Price \$ 6.50.

The original edition of this book, issued in 1948, was acclaimed as one of the most provocative works in recent scientific history. The new, revised second edition is indexed and contains two supplementary chapters.

The book is addressed to the intelligent layman and purports to explain the implications of the new science of Cybernetics and its possible effects on our society. However, little attempt is made to popularise the subject and many pages are filled with, what at first appears to be, abstract mathematics. The author glibly discusses his ideas in terms such as Newtonian time, Gibbsian statistics, ergodic theorems, Maxwell distributions, Gestalt, Brownian motion, non-Abelian groups and the like. These concepts are then employed to discuss developments in a wide variety of subjects ranging from computers to neuropsychology, from speed governing to homeostatic processes, from automation to heredity.

The word cybernetics is defined as control and communication in the animal and the machine—that is, the transmission of information to produce desired results. The essence of the method is the application of mathematical logic and probability theory to recognise the message being transmitted by filtering out the effects of the disturbing noise. The cyberneticist conceives

of man as a mechanism, the senses being merely means of transmitting information to the brain. These signals appear as pulses of current flowing along a complex network of neuron chains, producing different types of hormonal activity which give rise to our sensations and emotions. Tentative as it is, this theory has led the physiologist to new advances in sensory prosthesis, i.e., in the replacement of a lost sense by developing the ability to recognise information received from another sense, e.g., to read print by hearing. Also discussed is the hopeful possibility of restoring to artificial limbs the kinesthetic senses of position and velocity.

The author also explains ataxia, manic depression and homeostasis in terms of feedback and the oscillations observed in closed loop-control systems. In the new chapters he offers an explanation for brain waves and proves mathematically that these could be "organised" into a pattern by powerful external oscillations. Similarly, non-linear mechanisms could be forced into synchronism to form self-organizing systems. Considering reproduction, he describes machines that could be made to build other devices like themselves. He apprehends the dangers of these new ramifications of automation and points out the possibility of having these automata endowed with the ability to carry out, without human intervention, policies that may prove to be fatal to our civilization.

Mathematics apart, the main theme of the treatise is presented in a direct, absorbing manner and one is amazed at the manner in which the author rambles from communication engineering to physiology, from biology to automation, from economics to sociology, with the lucid competence of an expert. The going is heavy but the preserving reader is amply rewarded.

PREM J. BHATT.

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**Response of Metals to High Velocity Deformation**, Metallurgical Society Conferences, Vol. 9, A.I.M.E. Edited by P. G. Shewmon and V. F. Zackay. (Interscience Publishers, New York and London), July 1960. Pp. xii + 491. Price \$ 18.00.

This book, which covers the proceedings of the 8th Conference in the Technical series of the Metallurgical Society of the A.I.M.E. held in Colorado in July 1960, highlights the application and use of high strain rates for metal deformation, a field that has been attracting widespread interest. An international flavour is lent to the

subject and the book by the contributors from England, France, Canada and U.S.A.

The book has been conveniently divided into two main parts, the first consisting of some 6 papers and the discussions thereon and the second having 10 papers.

The first part under the caption 'High Velocity Deformation' deals with contributions on the effects of strain rates in thin specimens produced specifically by increasing the head speed, and the notation and symbols used herein are those standardised by Dr. Krafft. Instrumentation for high-speed strain measurement in a simple gas machine and a bar-block impact machine is described in the first paper. Then follows the observations of brittle behaviour produced by neutron irradiation on pure iron and a 0.21% C. steel. The increase in resistance of mild steel to the propagation of non-uniform yielding with increased dynamic rates of strain and low temperature is discussed next. The inapplicability of the elasto-plastic theory and the Malvern strain-rate theory to the comprehensive aspects of the strain-rate effects and the consequent use of the dislocation theory is described in an excellent paper by Prof. Dorn and his co-workers. This is followed by two papers on the structural changes in aluminium and copper single crystals and mild steel and crystallographic changes in aluminium single crystals, produced by high velocity deformation using explosive systems.

The various aspects of shock phenomena in metals are discussed in detail in Part II under some well-written ten papers. The first paper describes the shock wave concept, and some of its properties, the second the theory of moving dislocations, the third the dynamic shock properties of some alloys of iron and the fourth deals with the determination of the Hugoniot curves with a metallurgical technique. The value of metallurgical observations in studying the complex shock propagation phenomena is discussed next and then follows 5 papers dealing with the behaviour of iron and steel under impulsive loading, the nature of fractures, the production of Newmann bands, changes in microhardness and microstructure and the changes in mechanical properties in austenitic manganese steels caused by the passage of plane compressional shock waves.

The 16 papers, covered in this book, very well establish the general hydrodynamics of shock motion and clearly bring out the fact that any change in the thermodynamic parameter must be associated with structural changes both in the macro and the micro scale.

The book is profusely illustrated by diagrams, graphs and photo-micrographs and is an indispensable guide book to all those working on shock phenomena in metals and alloys.

A. A. KRISHNAN.

**The Fire of Life—An Introduction to Animal Energetics.** By Max Kleiber. (John Wiley and Sons, Inc., New York and London), 1961. Pp. xxii + 454. Price \$11.50.

The aim of this book is to give the reader an account of the fundamental concepts and basic relationship between rate of heat production and environmental temperature. The book consists of six parts. Part I deals with the subject of "The evolution of bioenergetics" which includes topics such as thermochemistry and source of animal heat. Part II deals with the subject of "Total starvation", Part III with "The physical aspect of metabolism", Part IV with "The metabolism of the starving animal", Part V "Food as fuel" and Part VI with "Food and population". These have been presented in simple language. The author has introduced simple principles of analytical geometry and calculus to show how generalisations, hypotheses and theories have been developed by applying mathematical analysis to observed data. The author has also critically examined the facts and figures presented. This book will prove highly useful to students of animal energetics.

M. SWAMINATHAN.

**The Chemical and Biological Action of Radiations, Vol. V.** Edited by M. Haissinsky. (Academic Press, London; India: Asia Publishing House, Bombay-1), 1961. Pp. xi + 278. Price 63 sh.

The fifth volume in the series covers the following subjects: (I) Mechanism of the radiolysis of water by gamma rays or electrons, (II) Action des rayons alpha sur les solutions aqueuses, (III) Diffusion kinetics in radiation chemistry, and (IV) Mass spectrometry and radiation chemistry.

The first paper gives a historical account of the development of radiation chemistry of aqueous solutions and emphasizes the fundamental contribution of Fricke to the subject. The criticism which was advanced against the radical theory in its early stages of its development and the arguments which have now finally brought the radical theory to prominence have been clearly put forward. The development and testing of the radical theory have been adequately described and the author



has also defined a number of problems that remain to be solved.

In the second article, which is in French, the radiation effects of alpha-particles on aqueous solution (which cannot be satisfactorily explained by the radical theory) have been accounted for, by postulating for intensely ionizing radiations, a zone of molecule-radical reactions,  $H_2 + OH$ ,  $H_2O_2 + OH$  and  $H_2O_2 + H$ , in the immediate vicinity of the trajectories of the alpha-particles. The relative importance of these reactions depends upon the nature and concentration of the solute. Several difficulties presented by this theory are pointed out and the author makes a few suggestions for improvement.

The third paper deals with the competition between the recombination of the radical and their diffusion away from one another by quantitatively describing it in terms of the macroscopic reaction rates and diffusion laws. The resulting equations which in general have no analytical solutions can now be solved by high speed electronic computers. In addition to the general formulation and criticism of the diffusion kinetic model, there are several analytical and numerical treatments of one radical model. The two-radical model, the effect of dose rate and the comparison with experiments are also given in some detail. The numerical calculations clearly show the extent to which the diffusion model explains the experimental results in the radiolysis of aqueous solutions.

The final article describes the principles, the apparatus and the technique of mass spectrometry as applied to radiation chemistry. It also contains a section dealing with ion-molecule reactions.

In general, all the articles have been written in a competent manner by distinguished experts in their respective fields. Each article has a list of valuable references for supplementary study. This book can be consulted with confidence.

H. B. MATHUR.

Galen on *Anatomical Procedures*. (The Later Books: A Translation by the late W. H. L. Duckworth.) Edited by Lyons and Towers. (Cambridge University Press), 1962. Pp. xix + 279. Price 40 sh.

Galen's *Anatomical Procedures* published in the final form, just a few years before his death, embodies the result of a lifetime of practical research. Only the first eight and a half books out of the 15 volumes have survived in the

original Greek and have been translated into English by the late Charles Singer. However, on the basis of an Arabic translation of the entire work, which was available, the last six and a half books have now been translated and presented in this volume.

The volume starts with the sixth chapter in the ninth book which deals with the dissection of the brain and experiments in brain surgery. The anatomy of the eyes, tongue, lips and movements of deglutition are surveyed in Book X. The Larynx and associated structures in apes and swine are described in Book XI. The generative organs and foetal development, dissection of veins and arteries, the anatomy of nerves arising from the brain and the spinal cord are the subject-matters of Books 12 to 15.

The volume while bringing to completion the entire *Anatomical Procedures* in English has also achieved its objective in focusing the attention of scholars and scientists on one of Galen's greatest works.

M. SIRSI.

Soil Micro-organisms and Higher Plants. By Prof. N. A. Krasil'nikov. (Published for the National Science Foundation, Washington D.C. and the Department of Agriculture, U.S.A., by the Israel Programme for Scientific Translation, 1961. Available from the Office of Technical Services, U.S. Department of Commerce, Washington D.C.) Pp. 474. Price 4.5 U.S. Dollars.

This book brings together most of the aspects of interaction between soil micro-organisms and higher plants which is engaging the attention of soil microbiologists. The subject-matter which is presented in a clear, readable style covers fundamental details of the structure, development, variability and classification of bacteria, actinomycetes and fungi in the light of recent research. Information is given at length on the importance of micro-organisms in plant nutrition, the rôle of microbial activities in the complementary nutrition of plants, the effect of microbes on the vitamin content of plants, their importance in plant growth and the part played by them in soil fertility.

The book is divided into four parts, namely, (1) Fundamentals of the structure and development of micro-organisms including the variability and classification of Actinomycetes, bacteria and phages. (2) The soil as an environment for micro-organisms: This deals with soil structure, soil respiration, thermal regime of the soil, soil insolation, organic matter and radioactive substances in the soil, the absorption capacity of

the soils and the ecological and geographical distribution of soil microbes. (3) Biological factors of soil fertility: Here is discussed mainly the effect of humus on plant development, and rôle of biotic substances of the soil and the effect of bacteria on the assimilation of nutrients by plants. (4) Interaction between soil micro-organisms and plants: This deals with most of the advances made in the study of rhizosphere microbiology with a note at the end on the epiphytic microflora.

Much of the material on soil microbiology, published in recent years by Russian investigators, is comprehensively discussed. The points of view on the subject that are considered to be of major importance in soil microbiology by the Russian scientists should be very useful indeed to workers in this field elsewhere. The book ends with a bibliography of 641 Russian titles (some of which are Russian translations of non-Russian material) and 829 titles by foreign authors, which, I think, is by no means complete. Omission of an Index at the end of the treatise makes reference rather difficult.

In view of the recent increased interest in the study of soil micro-organisms in relation to plant well-being, the book will be a good reference work for microbiologists, plant physiologists, soil specialists, plant pathologists, agrobiologists and agronomists alike.

V. AGNIHOTHRUDU.

**Mechanisms in Radiobiology.** Edited by M. Errera and A. Forssberg. Volume I. General Principles. (Academic Press, New York and London; India: Asia Publishing House, Bombay-1), 1961. Pp. 534. Price \$ 16.00.

All those who have read the papers in Volume II of this series (see *Curr. Sci.*, 1961, 30, 238), which for some unknown reason appeared a year earlier than Volume I, would be happy that this long-awaited publication has come out of the Press. It is no fault of the authors that much new knowledge particularly in the field of free radical measurements has become available since the papers of the current volume were written. Progress in radiobiological research, as in all other branches of science related to atomic energy, is so fast that any review paper is likely to become outdated even before it is published. Nevertheless, the basic facts do not change so fast—only views pertaining to the relative importance of the numerous pathways of radiation action on cells undergo periodic reassessment—and hence this volume dealing largely with general principles is of great value,

despite its belated publication. Research workers interested in radiobiology will welcome this excellent compilation of the basic facts concerning the action of radiations on cells, organs and organisms.

The volume begins appropriately with a paper on the physical principles of radiation action by F. Hutchinson and E. Pollard. Radiobiologists will find the discussion on radiation dosimetry and description of radioactive sources particularly useful. In a second part of the article, the same authors deal with the target theory of radiation action. They discuss the nature of radiation damage on molecules of various kinds and the relation of this damage to cell function. They rightly conclude that the simple biophysical theories built around statistical considerations are not wholly adequate to explain the effects of radiation on cells and that the physical changes which cause the loss of specific biological function are yet to be identified.

In the next paper, E. J. Hart and R. L. Platzman, describe the history and nature of Radiation Chemistry. The ionic yields in the radiolysis of inorganic gases, gaseous hydrocarbons, organic liquids and water are presented in well-constructed tables. The data from biochemical studies carried out in irradiated *in vivo* and *in vitro* systems are summarised by M. G. Ord and L. A. Stocken in the third chapter. They have incorporated in an addendum results from some recent studies on the effects of radiations on nucleic acids.

The cytological effects of ionizing radiation, particularly as observed by electron microscopy, are discussed in the fourth chapter by T. N. Tahmisián. With the aid of a few striking illustrations, the author has shown that the steps intervening between a small physicochemical change and a striking morphological result may have a topological basis, and that studies to bridge the gap between molecular configuration and ecology and those changes now readily observed by the electron microscopist are urgently needed. T. Alper describes the effects of radiation on subcellular units and free living cells. From a consideration of the possible mechanism of lethal and genetic effects on cells, the author concludes that either (a) it is a structure other than the "gene" which frequently acts as a target for cell killing, and even for the induction of mutation or (b) the gene as functionally defined must include chemical substances other than DNA.

The last two chapters on "Radiation Genetics" and "The Induction of Mutations as a Method of Plant Breeding" by S. Wolff and Å. Gustafs-

son respectively are masterpieces of condensation of the available knowledge on these topics. Those enthusiastic about the economic possibilities of mutation breeding would do well to note that Gustafsson, who more than any other living scientist is familiar with the possibilities of this technique, stresses that to achieve success the plant breeder should "study his crop plant carefully and learn to know its genes and linkage conditions, as well as its mutation spectrum, both under spontaneous conditions and after the application of different radiations and chemical mutagens". There is thus no hope of quick success for those who wish to add mutation research as an additional item to their already overloaded programme of research.

The Academic Press deserves both our gratitude and congratulations for providing this excellent source of authoritative information in a field of science characterised by explosive progress.

M. S. SWAMINATHAN.

#### Books Received

- Drugs, Medicines and Man.* By H. Burn (George Allen & Unwin Ltd., London W.C. 1), 1962. Pp. 232. Price 25 sh.
- Nutritive Values of Fruits, Vegetables, Nuts and Food Cures.* By Shaukat Usmani. (Shaukat Usmani, Y.M.C.A., Woodhouse Road, Bombay), 1962, Pp. ix + 192. Price Rs. 6-50.
- The Indian Ephemeris and Nautical Almanac for the Year 1963.* (The Manager of Publications, Government of India, New Delhi), 1961. Pp. xxvi + 462. Price Rs. 14.
- A Bibliography of Indology.* (Vol. 2)—*Indian Botany Part I, A-J* Compiled. by V. Narayanaswami. (The Librarian, National Library, Belvedere, Calcutta-27), 1961. Pp. xlii + 370. Price Rs. 8.
- Soil Microorganisms and Higher Plants.* By N. A. Krasil'nikov. (Academy of Sciences of the USSR, Moscow), 1958. Pp. 474. Price \$ 4.75.
- Polarised Light Production and Use.* By W. A. Shurcliff. (Harvard University Press, Cambridge, Massachusetts; India: Oxford University Press, Mount Road, Madras-2), 1962. Pp. ix + 207. Price Rs. 31-25.
- Fusarial Wilt (Panama Disease) of Bananas and other Musa Species.* By R. H. Stover. (The Commonwealth Mycological Institute, Ferry Lane, Kew, Surrey), 1962. Pp. vi + 117. Price 20 sh.

- Essay on Atomism: From Democritus to 1960.* By Lancelot Law Whyte. (Thomas Nelson & Sons Ltd., 36 park Street, London W.1), 1962. Pp. 107. Price 16 sh.
- Acharya Prafulla Chandra Ray—Birth Centenary Souvenir Volume.* (The Publication Committee, Calcutta University, Calcutta-19), 1962. Pp. x + 310.
- The Adrenal Cortex—British Medical Bulletin.* Vol. 18, No. 2, May 1962. (The Medical Department, The British Council, 65 Davies Street, London W. 1), Pp. 89-178. Price 20 sh.
- Proceedings of the Summer School of Botany.* Edited by P. Maheshwari, B. M. Johri and I. K. Vasil. (Ministry of Scientific Research and Cultural Affairs, Government of India, New Delhi), 1962. Pp. viii + 522. Price Rs. 25.
- Eighth Symposium (International) on Combustion—Held at the California Institute of Technology, Pasadena, August 28 to September 3, 1960.* (The William and Wilkins Co., Baltimore-2, Maryland, U.S.A.), 1962. Pp. xxviii + 1164. Price \$ 31.00.
- U.P. Scientific Research Committee Monographs—Ultrasonics and Colloids.* By Satya Prakash and A. K. Ghosh. (The Scientific Research Committee, U.P. Allahabad), 1961. Pp. 142. Price Rs. 8.
- The Origin of Science.* By E. H. Hutten. (George Allen & Unwin Ltd., Ruskin House, London W.C. 1), 1962. Pp. 241. Price 28 sh.
- Natural Organic Macromolecules.* By Bruno Jirgensons. (Pergamon Press, London), 1962. Pp. x + 464. Price 63 sh.
- The Chemistry of Flavonoid Compounds.* Edited by T. A. Geissman. (Pergamon Press, London), 1962. Pp. viii + 666. Price £ 7 10 sh.
- Role of Bluegreen Algae in Nitrogen Economy of Indian Agriculture.* By R. N. Singh (Indian Council of Agricultural Research, New Delhi), 1962. Pp. 175. Price not given.
- Errors of Observation and their Treatment* (3rd Edn.). By J. Topping (Chapman & Hall, London W.C. 2), 1962. Pp. 119. Price 7 sh. 6 d.
- Physics of the Nucleus.* By M. A. Preston. (Addison Wesley Pub., London W. 1), 1962. Pp. x + 661. Price \$ 15.00.
- Handbuch der Kolorimetrie* (Vol. 1)—*Kolorimetrie in Der Pharmazie.* By B. Kakac and Z. J. Vejdeck (VEB Gustav Fischer Verlag, JENA). Pp. xv + 1139. Price 79-20 DM.
- Advances in Astronomy and Astrophysics* (Vol. 1). Edited by Zdenek Kopal. (Academic Press Inc., New York-3, N.Y.), 1962. Pp. x + 366. Price \$ 10.00.

## SCIENCE NOTES AND NEWS

### Award of Research Degrees

The Utkal University, Cuttack, has awarded the Ph.D. degree in Chemistry to Shri Rabindra Kumar Nanda for his thesis entitled "Studies on Metal Chelates in Solution".

The Maharaja Sayajirao University of Baroda has awarded the Ph.D. degree in Botany to Shri Gunvantrai Maneklal Oza for his thesis entitled "Flora of Pavagadh".

Nagpur University has awarded the Ph.D. degree in chemistry to Sri. G. Bagavant for his thesis "Studies in reaction mechanisms: Studies in the mechanism of the Dieckmann cyclisation of Diethyl  $\beta$ -ethoxycarbonylpimelate and certain isomerisations related to it; and Synthetic approach to aldosterone analogues", and the Ph.D. degree in physics to Sri. P. L. Khare for his thesis "Investigations on the compressibilities of electrolytes by ultrasonics".

### Raptakos Medical Research Board Fellowships for 1963

The Raptakos Medical Research Board will consider applications for the award of Fellowships for research work on medical and allied subjects in recognized institutions situated in the Union of India.

The awards normally consist of Rs. 3,000 per year for a fellowship and Rs. 750 per year towards contingencies approved by the Board. Applicants should have an M.B., B.S. or M.Sc. degree or its equivalent or not less than two years' experience in research work after B.Sc.

Applications in the prescribed form, which may be obtained from the Secretary & Treasurer: Raptakos Medical Research Board, Dr. Annie Besant Road, Worli, Bombay-18, should reach before September 30, 1962.

### Regional Research Laboratory—Cotton Linters Utilization

The Regional Research Laboratory (Council of Scientific and Industrial Research), Hyderabad, will be holding a 'RESEARCH AND INDUSTRY MEET' on 6th and 7th September, 1962, to discuss the various aspects of the effective utilization of indigenous cotton linters and their upgrading. This 'RESEARCH AND INDUSTRY MEET' will provide a forum for a free exchange of views on the subject between research scientists, technologists and producers

and consumers of cotton linters. Further details may be had from the Director, Regional Research Laboratory, Hyderabad-9.

### Eighth Congress on Theoretical and Applied Mechanics

The Eighth Congress on Theoretical and Applied Mechanics will be held from December 23 to 26, 1962 at M.B.M. Engineering College, Jodhpur, Rajasthan.

Research papers on any of the undermentioned subjects should reach the Secretary with three copies of Abstracts by October 1, 1962: (1) Elasticity, Plasticity and Rheology; (2) Fluid Mechanics (Aerodynamics and Hydrodynamics); (3) Mechanics of Solids (Ballistics, Vibration, Friction and Lubrication); (4) Statistical Mechanics, Thermodynamics and Heat Transfer; (5) Mathematics of Physics and Statistics; (6) Experimental Techniques; (7) Computation Methods.

Any other information may be obtained from the Secretary, Dr. B. R. Seth, Indian Institute of Technology, Kharagpur, India.

**New International Journals.** (Published by Pergamon Press, Ltd., Headington Hill Hall, Oxford, England). Annual Subscription for each Journal: Institutions £ 10 (\$30.00.), Individuals £ 3.10 (\$10.00).

### Topology

This is an International Journal of Mathematics founded by Professor J. H. C. Whitehead, Oxford. The Editorial Board consists of Dr. M. F. Atiyah (Oxford), Prof. R. Bott (Harvard), Prof. F. Hirzebruch (Bonn), Dr. I. M. James (Oxford) and Prof. R. Thom (Strasbourg).

*Topology* will appear four times yearly and will publish papers in topology and related subjects. The contents of the first issue of the Journal, Vol. I, January to March 1962, are as follows: Limits and spectral sequences by Samuel Eilenburg and John C. Moore; Analytic cycles on complex manifolds by M. F. Atiyah and F. Hirzebruch; Über die Derivierten des inversen und des direkten Limes einer Modul-familie by Georg Nobeling; Vector fields on spheres by J. F. Adams; H-Spaces with few cells by J. F. Adams; and Remarks on the Plancherel and Pontryagin theorems by J. H. Williamson.

### **Electronics Reliability and Microminiaturization**

The object of this Journal is to bring together under one cover the various publications concerning reliability and microminiaturization which at present would appear in journals not specializing in these subjects. The Editor-in-Chief is G. W. A. Dummer (England). The first volume January to March 1962 of 100 pages contains 9 articles, four of which are on electronics reliability, and four on microminiaturization. Special mention may be made of the introductory paper on Reliability of Electronic Equipment by N. Griffin, and the review of British work on microminiaturization techniques by G. W. A. Dummer. W. Adcock and J. S. Walker have contributed an article on Semiconductor networks.

### **The Institute of Physics and the Physical Society, London**

1. *Conference on Ultra-High Energy Nuclear Physics.*—The Institute of Physics and the Physical Society is to sponsor a Conference on Nuclear interactions at ultra-high energies, to be held in the H. H. Wills Physical Laboratory, University of Bristol, on 7th and 8th January, 1963.

The main theme of the Conference will be strong interactions at energies above 100 GeV. observed in the cosmic radiation. The following are some of the main topics to be covered: Observations of high-energy cosmic ray collisions with emulsions and ionization calorimeters; The muon component and its interrelation with the characteristics of high energy collisions; Extensive air showers, and their propagation through the atmosphere; Field theoretical interpretation of high energy nuclear collisions.

Offers of contributions should be sent to the Conference Secretary, Dr. D. H. Perkins, H. H. Wills Physical Laboratory, Royal, Fort, Bristol 8.

2. *Electronic Processes in Dielectric Liquids.*—The Electronics Group of the Institute of Physics and the Physical Society, London, is arranging a Conference on Electronic Processes in Dielectric Liquids at the University of Durham from 23-25 April 1963. It is hoped to discuss the whole field of electrical conduction processes and breakdown in dielectric liquids such as simple hydrocarbons, liquid gases (including Helium), and purified insulating oils. Offers of papers not exceeding twenty minutes presentation time should be sent with three copies of abstracts of about 100 to 150 words as soon as possible and not later than 30 November 1962 to Dr. M. J. Morant, Department of Applied

Physics, Science Laboratories, South Road, Durham City.

### **High-Energy Electrons of Solar Origin**

The existence of high-energy electrons in the primary cosmic radiation has been well established in recent years. But their origin still remains an open question. Whether the sun which is known to emit high-energy protons, of range from 100 MeV to several BeV, especially during solar flares, can also be the source of electrons of similar range has been the subject of experimental investigation over the past year. P. Meyer and R. Vogt of the Enrico Fermi Institute for Nuclear Studies, University of Chicago, report an observation (*Phys. Rev. Letters*, 1962, 8, 387), which shows that electrons may be emitted by the sun during a solar flare and that the active region, which passed centre meridian on July 14, 1961, did indeed emit electrons with energies above 100 MeV which could be observed at the earth.

Five measurements with balloon-borne instrumentation were carried out in July to August 1961, from Ft. Churchill, Manitoba. The instrument was capable, over a certain range, of discriminating between electrons, protons, and heavier primary cosmic-ray particles. The first measurements took place on July 22, 1961, after the class 3<sup>+</sup> solar flares of July 18 and 20, 1961, which are known to have produced a large number of protons with energies up to several BeV.

On July 22, a considerably enhanced flux of primary protons which undoubtedly originated in one of the flares was observed. At the same time an increased flux of primary electrons was also observed, and subsequent comparisons with electron flux measurements after July 22 convincingly showed that the increased flux was due to solar emission. The measurement yields a flux of solar electrons of  $368 \pm 50$  particles/metre<sup>2</sup> sec. in the energy interval 100-300 MeV.

The acceleration of electrons in solar flares has been postulated to explain the solar radio bursts (Type IV) of non-thermal origin, which are observed at the main phase of many solar flares. Until now, however, no direct emission of high-energy electrons by the sun had been detected. It was assumed that magnetic fields in the flare region prevent the escape of energetic electrons.—(*Phys. Rev. Letters*, 1962, 8, 387.)

### **A New Xenon-arc Lamp**

The General Electric Company, U.S.A., has developed a new high-power xenon-arc lamp

which is nearly three times as bright as the Sun. The 5,000-W. lamp produces a total intensity of 275,000 lumens, or 55 lumens/W. Its first use is in a solar simulator for space vehicle investigations. In the visible, the light simulates sunlight, and its total spectrum, including the ultra-violet and infra-red, approximates closely to solar radiation. Another expected application is to optical masers. As a source of intense infra-red radiation it will also be useful in connection with solar-type furnaces. Housed in a parabolic reflector, the lamp throws a powerful beam of light, and, used as a searchlight, could throw a beam of  $10^9$  candle-power, sufficient to enable a person to read a newspaper at a distance of about 15 miles from the source.

The lamp is a direct-current light source in an ellipsoidal-shaped quartz bulb. The bulb is only  $3\frac{1}{2}$ " in diameter and  $4\frac{1}{4}$ " in length although the overall length of the lamp is about 19". The bulb houses two tungsten electrodes with an arc gap of 8 mm. and the arc operates in a high pressure of xenon. A high voltage is applied to start the lamp and a current of 145 amp. flows across the arc from the cathode to the large anode, which weighs  $\frac{3}{4}$  lb. The anode reaches a temperature of 6,000° F. The lamp is expected to have an operating life of 1,000 hr. This is the second lamp of its kind; the first was a 2,000 W. xenon-arc lamp and has been available for several months.

### New Results on the Chemical Composition of the Stars

The study of the chemical composition of stars has formed a major project at the Mount Wilson and Palomar Observatories in California during the past decade. As the programme has proceeded, more and more objects have been discovered whose chemical compositions deviate widely from those of the sun and nearby stars. If the composition of near-by stars be taken as a standard for comparison, one star—3 Centauri A—observed during the current year has four times the abundance of iron, five times the abundance of nitrogen, 100 times the abundance of phosphorus, 1,000 times that of Krypton, and 10,000 times that of gallium. On the other hand, oxygen and helium are deficient in this star by a factor of 6, and sulphur by a factor of 10. Observations also show that the isotope of helium of mass 3, rare in nearby stars, is several times as abundant in 3 Centauri A as the common isotope of mass 4.

Numerous other objects showing marked anomalies in abundance of chemical elements

have come to light in these studies. Often whole groups of stars and even whole galaxies show major anomalies. The most common deviation involves a deficiency in the heavy elements, including the common metals, all by about the same factor below their abundance in the sun and nearby stars.

As a result of these findings, it may be necessary to revise the calculations of distances in the universe which are based on the brightness of stars. Up to now, such distances have been determined on the assumption that stars of the same class, such as cepheid variables of the same period, have the same luminosity. The discovery of different chemical compositions among the stars may alter this assumption.—(*Carnegie Institution Year-Book* 60.)

### Superconductivity of Iridium

Following the recent discovery that very pure molybdenum is a superconductor (T. H. Geballe, *et al.*, *Phys. Rev. Letters*, 1962, 8, 313), it has now been shown that iridium of very high purity is likewise a superconductor with a zero-field transition temperature of 0.140° K.

It is known that the existence in a superconductor of an impurity such as iron drastically lowers the superconductivity transition temperature, if, and only if, the iron impurity possesses a localized magnetic moment. Localization of the Fe moment has been found to be a function of valence electrons possessed by the host metal. Molybdenum and Iridium are two transition metals in which Fe, if present as an impurity, would possess a localized magnetic moment.

The present discovery of the superconductivity of iridium and the recently reported discovery of the superconductivity of molybdenum suggest that failure of many metals to exhibit superconductivity, even when cooled to ultra-low temperatures, could be due to insufficient purity.

The metal iridium has previously been reported to be non-superconducting down to 0.1° K. However, bearing the above considerations in mind in the present experiment, reported by Geballe *et al.*, and Hein and Gibson (*Phys. Rev. Letters*, 1962, 8, 408), improved techniques have been used to effect extreme purification of the sample of iridium from the original supply certified to contain only 2 p.p.m. of impurity.

These results suggest that superconductivity is probably a more widespread phenomenon than presently believed.

### New High-Energy Electron Accelerator

The new Cambridge Electron Accelerator, which is a joint undertaking of Harvard University and the Massachusetts Institute of Technology, has gone into operation early in March 1962, generating a 2.2 BeV beam—the most energetic electron beam yet produced by man. Its designed output, a beam of electrons travelling at 999999996 the speed of light and with an energy of 6 BeV, should be attained this summer.

Like the 30-BeV proton accelerator at Brookhaven and CERN, the Cambridge machine is a synchrotron: it accelerates particles held in a circular orbit by a magnetic field. Charged particles moving on a curved path lose energy by electromagnetic radiation, and with electrons having an energy approaching 10 BeV this loss nullifies any increases in power. Electrons with an energy more than 10 BeV can be generated only in huge linear accelerators, such as the 2-mile long 20-45 BeV machine to be built at Stanford University.

Machines like the Cambridge accelerator nevertheless have a key part to play in critical areas of nuclear physics. Until now exotic fundamental particles have been created in the laboratory chiefly with high-energy protons. Such particles can also be produced by 6-BeV electrons, and the processes involved should be easier to analyze because electron interactions involve only the well-known electromagnetic forces and not nuclear forces, which are not so clearly understood.—(*Scien. Amer.*, 1962, 206, 80.)

### Ruby Optical Maser as a Raman Source

The first successful use of the ruby optical maser for excitation of Raman spectra is described by S. P. S. Porto and D. L. Wood of the Bell Telephone Laboratories, in a communication to the *Journal of the Optical Society of America* (1962, 52, p. 251).

A successful Raman source must have high radiance, strict monochromaticity, and a frequency

for which the sample is not opaque. The ruby optical maser of wavelength 6940 Å has, from its first demonstration, been an obvious possibility for this purpose.

In the experiment described by Porto and Wood the exciting lamp was a G.E. FT 524 xenon flash lamp. The ruby rod of 0.05% Cr concentration was supplied by the Linde Company. The ends of the ruby rod was polished flat to 1/5 fringe, and parallel to 30 sec. of arc. One end of the rod was coated with an opaque silver layer, but the other end had a silver coating of 25% reflectance. A flow of gas through a pyrex tube surrounding the ruby rod effected its cooling.

The slightly divergent light beam from the end of the ruby rod was focused with a lens to a spot several millimetres in diameter on the surface of the Pyrex Raman cell. The radiation entering the cell was diffusely reflected many times through the sample by a coating of BaSO<sub>4</sub> deposited on the surface of the cell. The scattered light from the cell was collected by a lens and brought to a focus on the slit of a high aperture spectrograph.

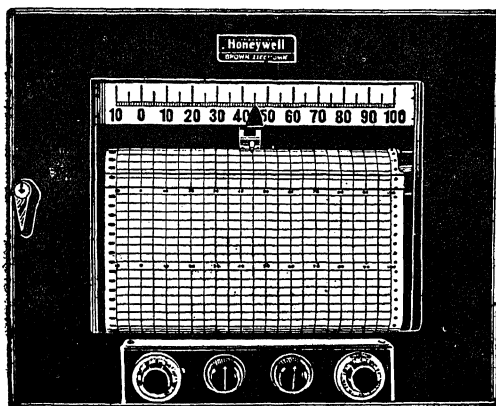
The maser was operated about three times a minute with a flash energy of 3,000 joules producing flashes having a total duration of one millisecond. The exposures were recorded on Eastman 35 mm. type IN spectrographic film, and each exposure involved from 1 to 100 flashes, depending on the experiment. The distance between the maser rod and the Raman tube was kept at 150 cm. Raman spectrograms of benzene and carbon-tetrachloride, recorded with 50 flashes of the maser, showed all the well-known Raman lines of these substances.

It hardly needs to be pointed out that this intense, truly monochromatic source at 6940 Å in the red, is ideally suited for studying the vibrations of molecules of absorbing substances, of fluorescing materials, and for low-lying frequencies. Studies of the coherent Raman effect may also be possible, though this has yet to be demonstrated.—(*Jour. Opt. Soc. Amer.*, 1962, 52, 251.)

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# THE ROLE OF THE RETINA IN VISION

SIR C. V. RAMAN

## 1. INTRODUCTION

OUR sense-organs are the gateways through which a knowledge of the external world reaches us. The relationships which exist between our sensory impressions and the nature of the stimuli which excite those impressions are thus matters of great importance. For, they furnish us with indications regarding the processes by which the stimuli received by the sense-organs are transformed into sense-impressions. Studies on the perception of stimuli of the simplest character are particularly important, since their results are most readily analysed and understood.

Light which appears as a sharply-defined line in the spectrum is the simplest type of radiation. It is appropriate therefore that we recognise the sensations excited by monochromatic lights of various colours as the primary or fundamental visual sensations. Likewise, when a continuous spectrum of radiation is dispersed by a prism into a band of colour, each strip which the eye can distinguish as being different in hue from the strips on either side can be regarded as a primary or fundamental visual sensation. Hence the primary visual sensations are as numerous as the hues which can be distinguished from each other in the spectrum by the eye under the most favourable conditions of observation.

We may here usefully recall various facts of observation. It is known that as many as 250 different hues in the spectrum can be distinguished under appropriate conditions. The spectral shift which results in an observable change of hue is less than twenty angstroms over the greater part of the spectrum and as little as ten angstroms in some parts. It is also known that the addition of white light in any desired proportion to a pure spectral colour does not change the observed hue. Quantitative studies have further established that the power of the eye to discriminate between the hues of adjacent regions in the spectrum is not sensibly diminished even when the colours are diluted by considerable additions of white light to the fields under comparison.

The facts of experience stated above are just what we would expect to find if the colours of homogeneous light are the primary or fundamental colour sensations. That such a relationship exists is not in the least surprising. For,

our organs of vision would be of little use to us, if the external stimuli and the sensations which they excite are not very simply related to each other. We are, therefore, entirely justified in concluding that the basic or primary sensations with which physiological optics has to concern itself are those produced by the radiations which are recognised by the physicist as simple and homogeneous. These sensations stand in a category by themselves and they are clearly distinguishable from the sensations excited by compound or heterogeneous radiation.

The basic problem in physiological optics is thus to find an answer to the question, how does the apparatus of human vision function and enable us to distinguish the colours of monochromatic lights from each other with the degree of precision actually observed?

## 2. THE NATURE OF THE VISUAL PROCESS

Geometrical optics and the wave-theory of light form an appropriate basis for a consideration of the propagation of light in refractive media. Thus, they enter into the realm of physiological optics when we consider the functioning of the cornea and the crystalline lens and the formation of images of external objects on the retina. But when we reach the retina, wave-optics ceases to be relevant, and Einstein's concept of light as consisting of discrete energy-quanta or photons necessarily takes its place. For, the wave-theory is incapable of giving any acceptable explanation of such phenomena as the emission or absorption of light and the transformations of light-energy. Hence, we must lay aside the ideas and language of the wave-theory and think of light as a stream of photons, if we are to make any progress towards an understanding of the facts of human vision.

Homogeneous light may be described as a stream of radiant energy consisting of units or quanta which are all identical. The quanta increase progressively in magnitude as we move up the spectrum from the red towards the violet end. The colour of the perceived light also changes progressively in the same circumstances. We are, therefore, justified in associating the sensation of colour experienced in homogeneous light with the energy carried by the individual photons or light-quanta. The other sensation

excited by light, *viz.*, its luminosity, is determined by the number of photons traversing any given area per unit of time. Thus, the two physiologically experienced sensations of colour and luminosity excited by homogeneous light are connected respectively with the two specifiable properties of the radiation in the language of the quantum theory.

A fuller insight into the nature of the visual process is furnished by quantitative data of two different sorts which are available regarding the sensations excited by homogeneous light. These data are represented in the form of the curves known respectively as "the luminous-efficiency curve" and "the hue-discrimination curve" of the visible spectrum. The luminous-efficiency curve exhibits the results of a comparison of the visual luminosity of the different parts of the visible spectrum for a constant energy-flux. The hue-discrimination curve represents determinations of the smallest difference of spectral position necessary to give an observable difference in colour between two fields of illumination, the luminosities of which are equal.

The data of observation represented in the hue-discrimination curve are particularly significant. In the entire range of the visible spectrum, a change in the energy of the photon of one per cent. is sufficient to give a perceptible change of colour. Indeed, this statement underestimates the power of the visual mechanism to perceive differences of colour. Except near the ends of the spectrum where the luminosity is low, a change of one-half of one per cent. in the energy of the photon is everywhere detectable. In the blue-green region, a change of one-fifth of one per cent. and in the orange-yellow, of one-sixth of one per cent. reveals itself by an alteration of the observed colour.

The facts of experience stated above are most readily understood if vision is assumed to result from the acceptance of the energy of the photon by the retina and its immediate transference without addition or subtraction to the centres of perception. We do not have to assume that all the photons incident on the retina are thus dealt with. A considerable proportion, especially in daylight vision, may be expected merely to pass through the retina and suffer absorption by the pigmented choroid coat behind it. The energy of the other photons may be expected to be used up in producing thermal effects or photochemical changes in the substance of the retina. The photons thus disposed of cannot be effective in vision. The observed precision of the colour sense over the entire visible spectrum precludes any such possibility.

The distribution of visible luminosity in the continuous spectrum of radiation emitted by a hot body differs greatly from the distribution of energy in it. This difference is a characteristic property of human vision and arises from the enormous differences between the luminous efficiencies of homogeneous radiation in the different parts of the spectrum. The efficiency exhibits a pronounced maximum in the green and falls off rapidly as we proceed away from it either towards the red or towards the violet end of the spectrum, but more rapidly so in the latter case. Indeed, the luminosity of the violet end of the spectrum is very low. These differences in the ability of photons of different energies to excite the sensation of luminosity are ascribable to the differences in the probability of their energies being taken over by the retina and transmitted to the centres of perception as indicated above. On this basis, we should expect to find noticeable relationships between the variations of luminosity and of colour in the different parts of the spectrum, and this is actually the case. We shall return to these topics later.

### 3. THE SPECTRAL SENSITIVITY OF THE RETINA

A technique of observation has been devised and used by the author which is both simple and effective and which enables an observer to see a greatly enlarged picture of his own retina in the act of functioning. The technique enables highly important information regarding the structure of the retina and its sensitivity to light in different areas and in different parts of the spectrum to be obtained.

We may first briefly explain the technique and how it works. By screening the eye from all external illumination for a short period which need not exceed a few minutes, it is possible greatly to increase the sensitivity of the retina to light. This improvement may be made spectrally selective, in other words, restricted to any desired part of the spectrum by using an appropriately chosen colour filter and holding it before the eye for a suitable interval of time. Accordingly, when the filter is removed and a brightly lit white surface is viewed by the observer, he sees on it a picture of his own retina which exhibits the selective responses of its different areas to the parts of the spectrum which had been screened off by the filter before its removal. This picture, of course, is fugitive. But it may be recalled as often as desired by putting back the filter and then removing it from before the eye.

A series of ten drawings of the retina showing the effects observed with different colour-filters in the manner explained above are reproduced in the accompanying colour plates. The colour-filters were prepared by dyeing gelatine films on glass with different water-soluble dyes to an appropriate depth of colour and then washing and drying the film. The commercial names of the colouring matters used are entered against each figure. We shall proceed to comment briefly on the effects noticed with the different filters.

It is significant that a rhodamine filter, which cuts off the green sector of the spectrum without weakening other regions, gives no observable effect following its removal. This indicates that the sensitivity of the retina to the green which is the most luminous part of the spectrum is not sensibly enhanced by its being screened off from the eye for a brief period.

Very striking and beautiful effects are observed using a filter dyed with methyl-violet. The density of the filter and the accompanying changes in the strength of the absorption and the extent of cut-off in the spectrum greatly influence the observed results. In all cases, the foveal area and the foveolar depression are conspicuous features, the colour which they exhibit varying with the density of the filter. A lightly-dyed filter cuts off the yellow and orange sectors and weakens the green of the spectrum. With such a filter, the foveal region appears green, while yellow and orange are the dominant colours elsewhere in the field. A halo of orange-red hue appears encircling the foveal disc (Fig. 1 in the colour plate).

Using filters whose absorption is at the violet end of the spectrum and which accordingly appear yellow or orange by transmitted light, the retina exhibits a blue glow following the removal of the filter (Fig. 9 in the colour plate). With filters which cut off the red of the spectrum and allow the rest to pass through freely, a rose-red glow appears covering the entire field following the removal of the filter (Fig. 3 in the colour plate). The fovea is either not seen at all or is only very dimly visible in the retinal picture in these cases. Filters which appear green or greenish-blue by transmitted light usually exhibit a cut-off at both ends of the visible spectrum. If the cut-off covers the yellow and orange regions of the spectrum, the retinal picture shows the fovea very clearly as an yellow ring with a bright yellow spot at the foveola (Figs. 4, 8 and 10). With the more deeply coloured filters, the foveal

region appears also encircled by a halo or haloes (Fig. 6).

A variety of blue filters may be prepared by dyeing gelatine films on glass. All such filters cut off the yellow and orange regions of the spectrum, and hence when they are used, the fovea is invariably seen in the picture, the colour which it exhibits and the colour of the surrounding field varying with the nature of the spectral cut-off by the filters. Very similar effects may also be observed using commercially available blue glasses. If such a filter cuts out the green, yellow and red sectors completely, its transmission is a clear deep blue of low intensity. When a filter of this kind is held against the eye against a bright background and then suddenly removed, a multi-coloured picture flashes into view in which the fovea with the foveola at its centre appears as a bright disc surrounded by a less luminous field and further encircled by a halo. This picture slowly fades away.

#### 4. OBSERVATIONS WITH POLARISED LIGHT

The use of a polaroid in combination with a colour filter in observations of the kind described above reveals some highly significant facts. It may be stated at once that the special effects observed with polarised light are restricted to the foveal area on the retina. They are seen with filters transmitting the violet and blue sectors of the spectrum and are unobservable with filters which do not transmit those parts of the spectrum. The use of filters which transmit other parts of the spectrum besides the blue and the violet serves only to dilute the observed effects and make them less readily observable.

We shall now proceed to state what is actually observed. Placing a blue filter in front of the eye, a bright field of illumination is viewed; after a few minutes, a polaroid is placed in front of the filter. A dark brush shaped like a dumbbell crossed by a bright brush of similar shape then springs into view in the foveal area of vision. This picture slowly fades away. The polaroid is then suddenly removed, the blue filter remaining in place. *The brushes then reappear, but turned through a right angle, in other words, the bright brush takes the place of the dark brush and vice-versa.* This again duly fades away. The observations may be repeated as often as desired.

Observations of the same nature may also be made with the polaroid alone but without any colour-filter. Putting the polaroid in front of

the eye, we observe the well-known phenomenon of Haidinger's brushes, a feeble yellow brush crossed by a blue brush appearing in the foveal area of vision. When this has faded away, the polaroid is suddenly removed. The brushes then reappear but with the yellow brush and the blue brush interchanged in their positions.

Another significant result emerges when the brightness of the field against which these brushes are viewed is varied. The polaroid and the blue filter should be used together so that the brushes are seen with the maximum clarity. Their fading-away is obviated by the simple device of oscillating the polaroid in its own plane through a right angle, so that the brushes remain continually visible, though constantly shifting their position. When the brightness of the field viewed by the observer through the polaroid-filter combination is progressively diminished, it is found that the visibility of the brushes vanishes when the level of illumination is reduced to the point at which the blue colour of the light becomes inconspicuous. In other words, the phenomena exhibited in polarised light are confined to the photopic levels of illumination and disappear when we pass into the scotopic range.

##### 5. THE VISUAL PIGMENTS : XANTHOPHYLL

We shall now proceed to make use of the facts and results set forth in the preceding pages to establish the chemical identity of the colouring matters present in the retina which enable it to function as a receptor of vision in the photopic range of illumination. The functioning of the retina in the lowest or scotopic levels of illumination will not be dealt with here.

Xanthophyll is a plant pigment of very wide occurrence. Its chemical name is dihydroxy- $\alpha$ -carotene and its chemical formula is  $C_{40}H_{55}O_2$ ; it is dextro-rotatory and has no vitamin-A activity. The spectral properties of xanthophyll are similar to those of  $\alpha$ -carotene. Xanthophyll is sensibly transparent for all wavelengths greater than  $520 m\mu$ ; the absorption-strength becomes sensible at  $500 m\mu$  and rises very steeply beyond  $490 m\mu$ ; it reaches a pronounced maximum at  $477 m\mu$  and this is followed by a second and even more pronounced maximum at  $448 m\mu$ . It falls off at shorter wavelengths and after exhibiting a third and minor maximum at  $420 m\mu$  goes down steeply to small values beyond  $400 m\mu$ .

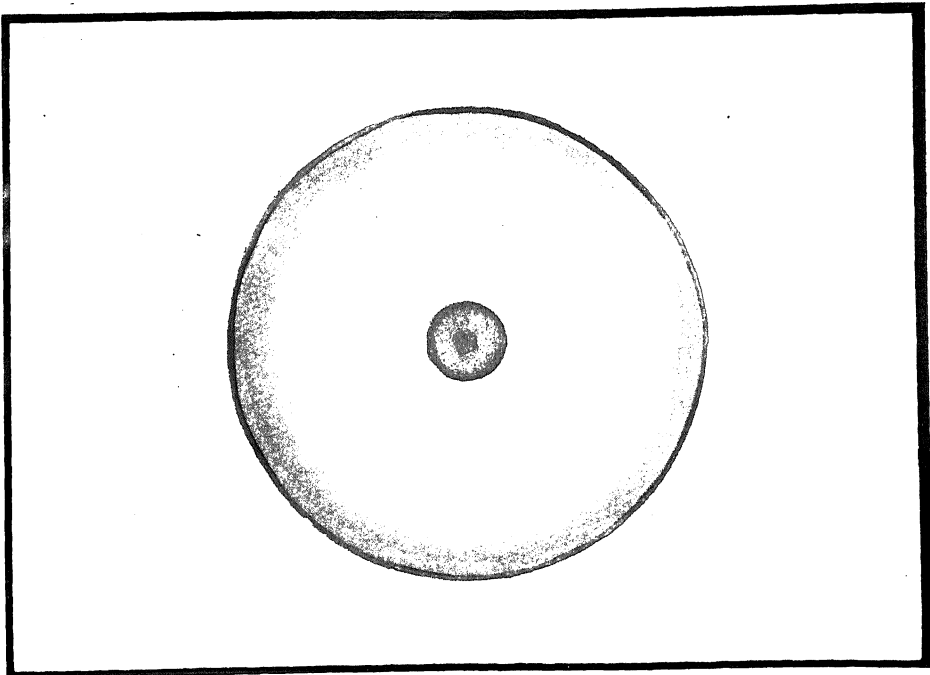
Like all the carotenoid pigments, xanthophyll exhibits in its structure a long chain of conjugated carbon-carbon double bonds, to which

it owes its power to absorb light in the visible region of the spectrum. It may be remarked that this absorption appears only in the violet and blue sectors of the spectrum. The presence of xanthophyll in the retina is unquestionable. Indeed, the yellow colour of the *macula lutea* has long been known and that it is due to xanthophyll was established by extraction and the study of its absorption spectrum, notably by Wald. What we are now concerned with is to demonstrate that xanthophyll is the visual pigment which enables the eye to perceive light and colour in the violet and blue sectors of the spectrum. Several items of proof are forthcoming which will be set out in proper order.

The absorptive properties of xanthophyll account satisfactorily for the observed features of colour and luminosity in the spectrum. The region between  $490 m\mu$  and  $440 m\mu$  usually marked out as the blue sector in the spectrum is also the region where the absorption of xanthophyll rises steeply from very small values to maximum strength. The region beyond  $440 m\mu$  designated as the violet sector of the spectrum is also the region where the absorption of xanthophyll having passed its zenith drops down to small values.

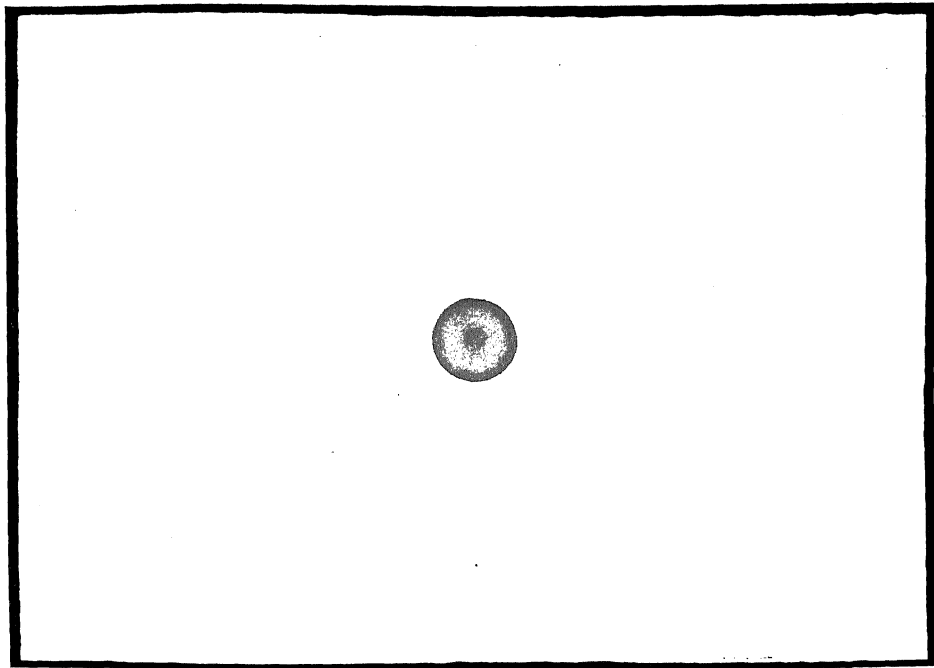
The wavelengths at which the absorption-curve of xanthophyll exhibits its steepest gradients are also the wavelengths at which the hue-discrimination curve in the spectrum exhibits the most pronounced dips, in other words, the wavelengths at which the spectral shifts necessary to produce an observable change of colour reach their minimum values. The very steep rise in absorption at  $490 m\mu$  corresponds exactly with the conspicuous dip of the hue-discrimination curve at  $490 m\mu$ . The second and much less conspicuous dip of the hue-discrimination curve at  $440 m\mu$  also coincides in its position with the steep fall of the absorption of xanthophyll after it has reached its maximum value.

The effects observed with polarised light and described in the preceding section are a conclusive demonstration that xanthophyll is the visual pigment for the blue and violet sectors of the spectrum. They are explained as follows: Xanthophyll has long-chain molecules containing an alternation of single and double bonds; they can absorb light and function as a visual pigment only if the light is polarised with the electric vibrations parallel to the chain-structure of the molecules. On the slopes of the foveal area, the nerve fibres have a radial setting. In that region, therefore, the xanthophyll molecules lie parallel to the nerve fibres and also have a radial setting. Hence, in the

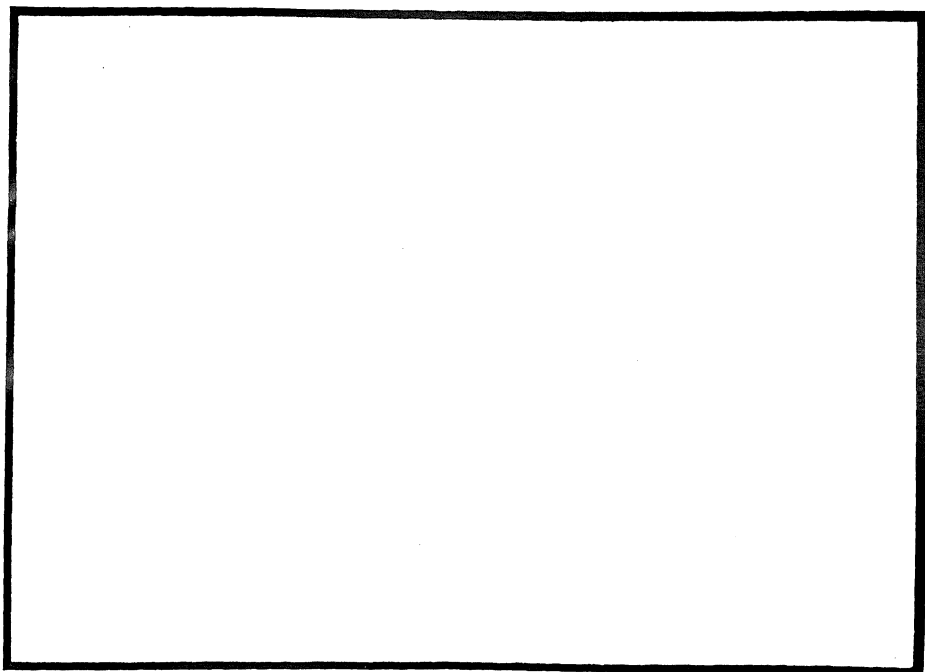


*Fig. 1. Methyl Violet*

*Fig. 2. Coomassie Brilliant Blue*

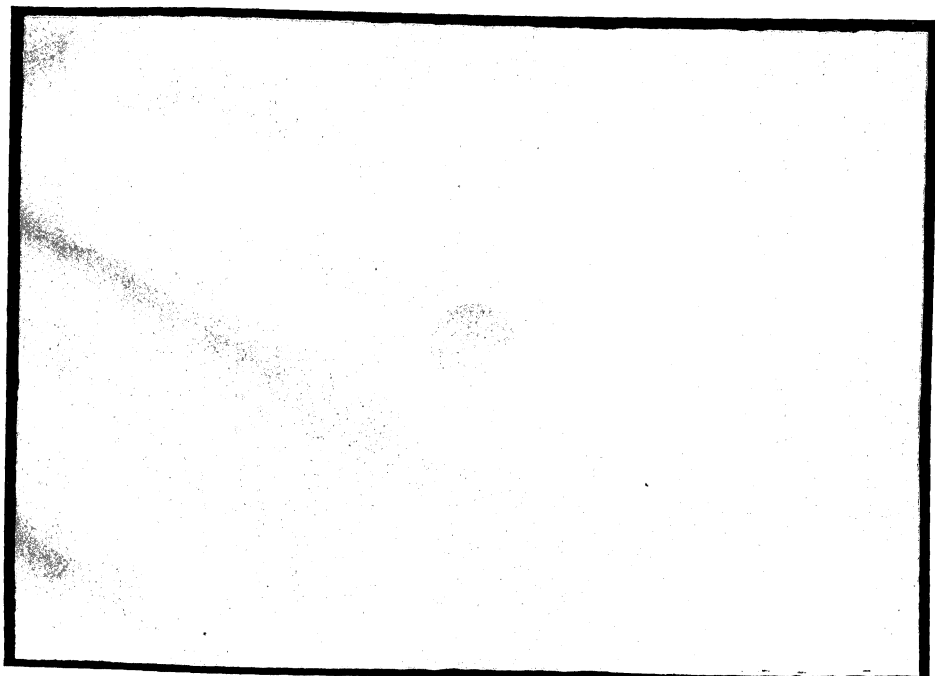






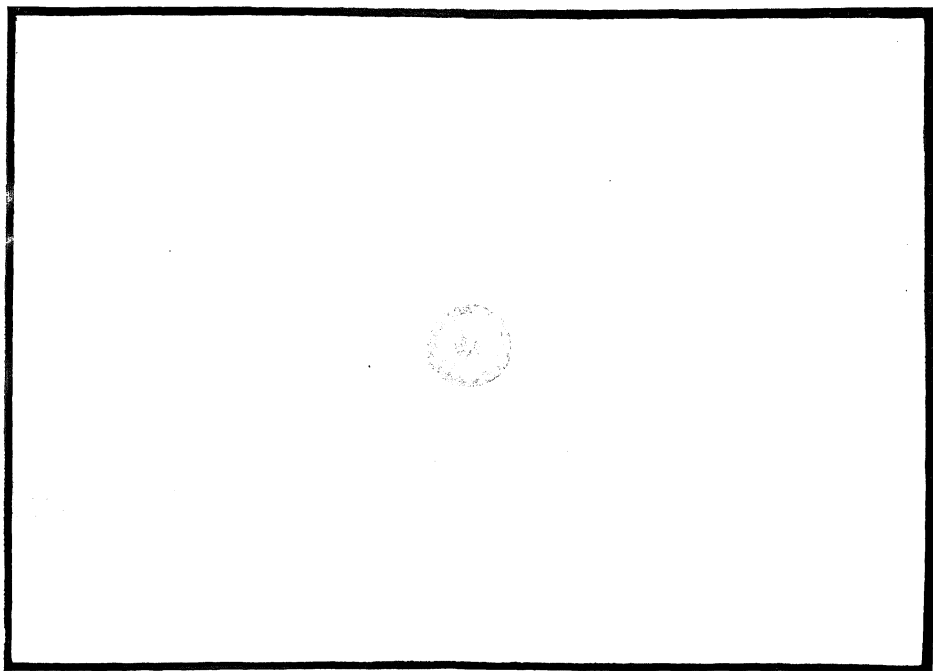
*Fig. 3. Light Lissamine Green*

*Fig. 4. Nickel Chloride*



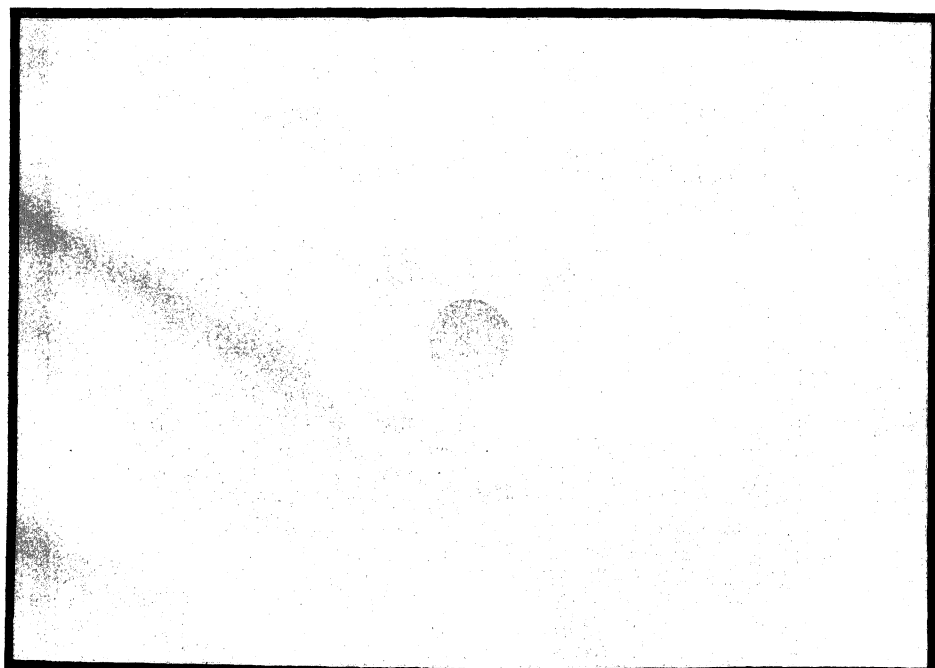


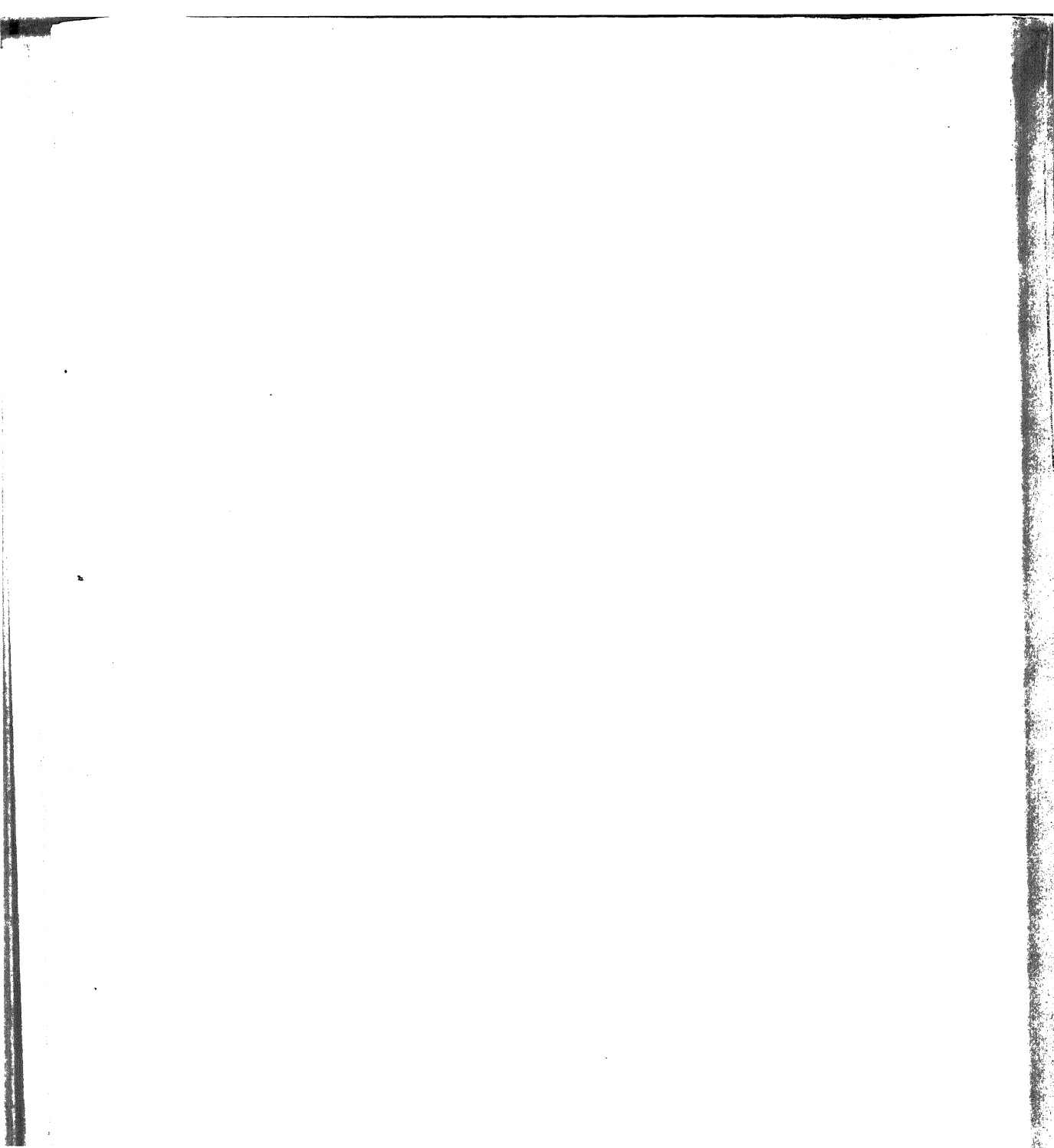


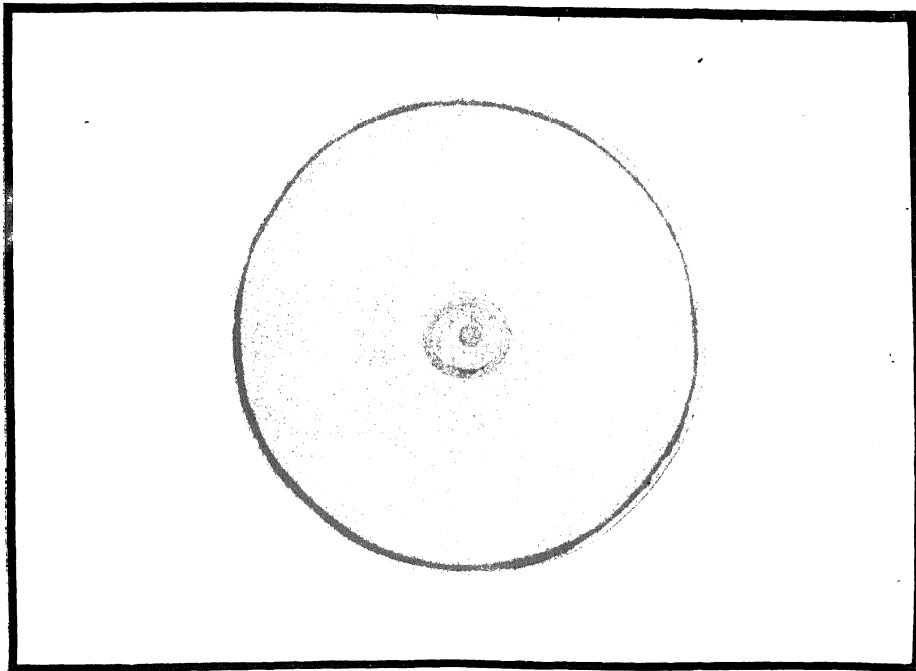


*Fig. 5. Coomassie Navy Blue*

*Fig. 6. Deep Lissamine Green*

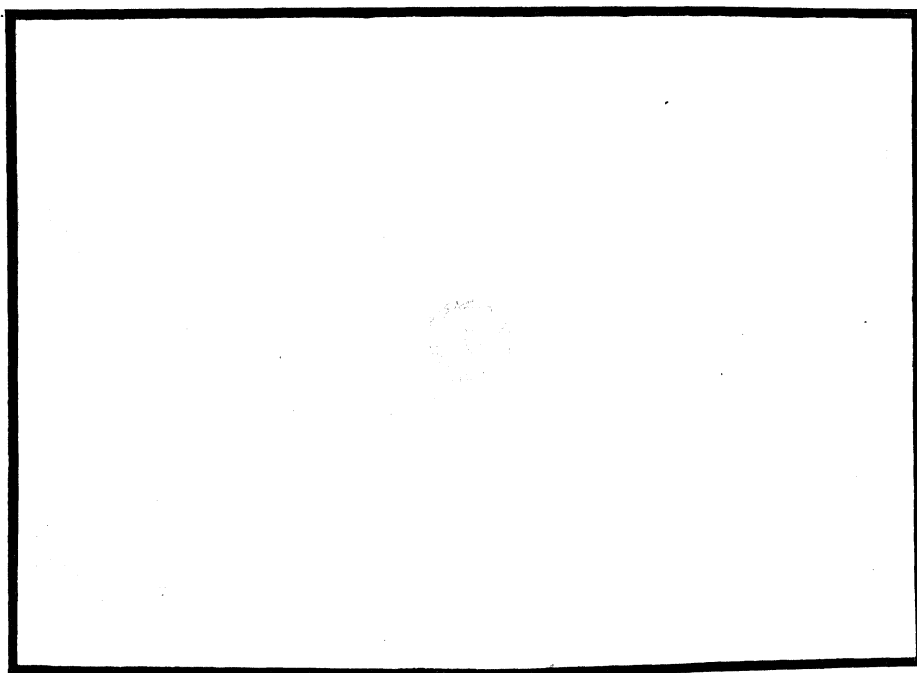




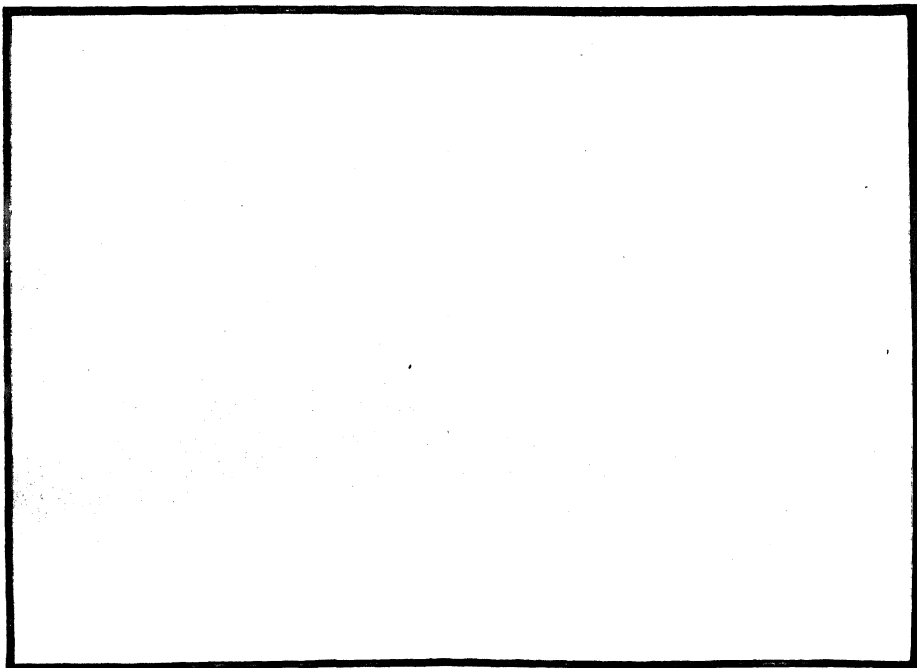


*Fig. 7. Deep Blue*

*Fig. 8. Greenish Blue*

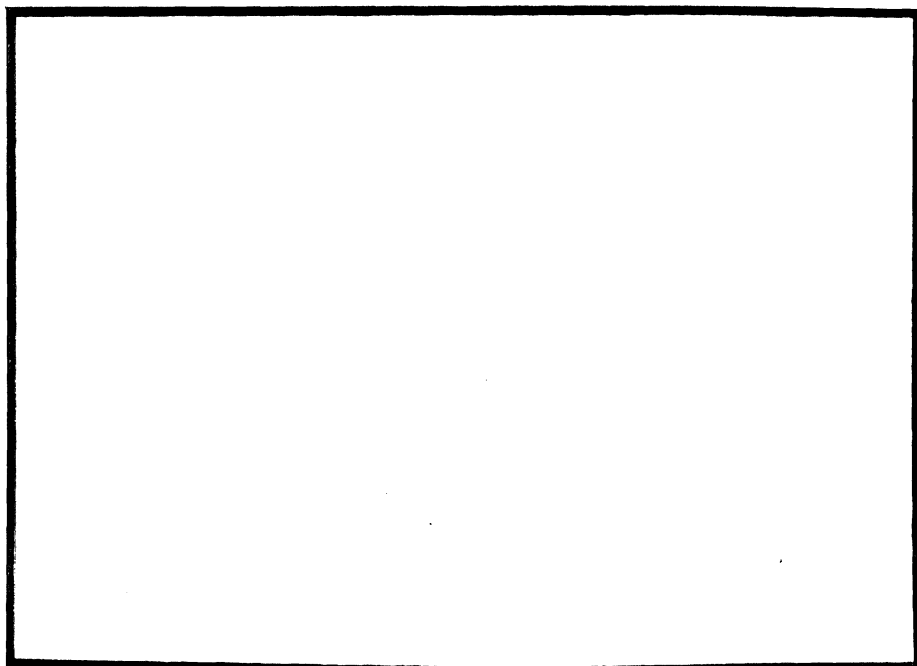


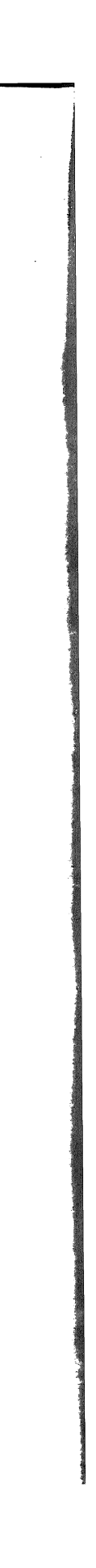




*Fig. 9. Deep Orange*

*Fig. 10. Light Green*





foveal area, a bright brush is seen in the same plane as the electric vector of the incident light and a dark brush in the transverse direction. That the brushes are visible only in the blue and violet sectors of the spectrum and not elsewhere is readily intelligible. For, the absorption of light by xanthophyll appears only in the former regions and not elsewhere.

That the brushes reappear turned through a right angle following the removal of the polaroid has already been mentioned. This is a further proof that we are here concerned with a physiological phenomenon and not with an effect of physical origin. When the polaroid is kept before the eye long enough, the sensitivity of the foveal region to light is enhanced in the region of the dark brush and diminished in the region of the bright brush. Hence, when the polaroid is taken out, the brushes are seen again but with the dark and bright brushes exchanged in their positions.

Xanthophyll functions as a visual pigment only under photopic conditions. It is therefore to be expected that the brushes observed in polarised light over the area of foveal vision disappear when the illumination is reduced from the photopic to the scotopic level.

## 6. THE VISUAL PIGMENTS: HEME-PROTEINS

The observations with colour filters described earlier make it evident that the pigments which enable the retina to function in the red and green sectors of the spectrum are different. However, it is also clear from those observations that there is an overlap of the regions of the spectrum in which the two pigments function and that they co-operate in the perception of light and colour in the regions of such overlap. It is in these regions that the spectral colours of yellow and orange are perceived.

That the pigments which enable us to perceive the green and the red of the spectrum are heme-proteins of the ferrous and ferric types respectively is indicated by various considerations. In the first place, the absorption of light by these pigments appears in just those regions of the spectrum where they are needed to account for the observed facts of vision. Ferroheme exhibits a pronounced maximum of absorption around 550 m $\mu$ . Likewise, the luminous efficiency in the spectrum exhibits a highly pronounced maximum around 550 m $\mu$ . Accordingly, we are justified in recognising ferroheme as the visual pigment which functions in the green sector of the spectrum. Ferriheme behaves differently. Its absorptive power is

much weaker than that of ferroheme in the green but is much stronger in the red. Hence, we are led to assign to ferriheme the role of the visual pigment which functions at the red end of the spectrum.

As is well known, defects and anomalies in the perception of red and green in the spectrum are fairly common. It is very significant that these defects and anomalies are congenital and that they are transmitted from generation to generation according to the laws of heredity. Further, whereas the condition of night-blindness arising from dietary deficiency can be rapidly cured by an adequate addition of vitamin A to the food consumed, the defects of photopic colour-vision cannot thus be dealt with. These facts very clearly indicate that the visual pigments which enable us to perceive the green and the red of the spectrum are products of biological activity in the human body itself and that they are not plant products which have entered the retina by way of the articles of food consumed.

Having thus set aside the possibility of the carotenoids being the visual pigments for the green and the red, we naturally turn to the other great class of pigments of biological origin, viz., those in which the chromophore is a tetrapyrrolic group with a metallic atom located at its centre. Thus, by a simple process of exclusion, we are led to the identification of our visual pigments as heme-proteins, as already indicated. Heme is ubiquitous and we need therefore have no hesitation in assuming its presence in the retinal structures. The analogy with the activity of chlorophyll in the green leaves of plants indicates that heme which is a powerful absorber of light is also capable of transferring the energy absorbed to the retinal structures and thus enabling it to be perceived. Heme is also fairly stable chemically. Though a substantial fraction of the incident photons may be used up in effecting photochemical changes, enough would be left over to make vision in daylight both possible and efficient.

## 7. DEFECTS AND ANOMALIES OF COLOUR VISION

The characteristics of the rare condition known as tritanopia may be explained as arising from the absence of the pigment xanthophyll from the retina. The defects and anomalies of colour vision more commonly met with appear in the part of the spectrum between the termination of the blue and the extreme red end. The recognition that the heme pigments in the ferrous and ferric states are the mediators of vision in these regions makes these

defects and anomalies explicable. Indeed, it is also possible to elucidate in detail the results of quantitative studies of those defects and anomalies. The subject has been fully discussed in an earlier memoir by the author (Reference 1). It will therefore suffice here to indicate broadly the approach developed in that publication.

As has already been explained, ferroheme is the visual pigment functioning in the green and ferriheme in the red; in the region of overlap of the absorption spectra of the two pigments, homogeneous light exhibits the various intermediate colours. The precise sequence of the luminosity and colour observed would evidently depend on the proportions of ferroheme and ferriheme functioning in the retina. The proportion in which iron is present in the ferrous and ferric states would presumably be determined by some regulating biochemical mechanism. Any malfunctioning of that mechanism would result in an alteration of the proportion in one direction or the other. This is the clue to the explanation of the observed deviations from the normal in the perception of light and colour.

If ferriheme be totally absent in the retinal pigment, the observer would fail to perceive the red end of the spectrum and the latter would therefore appear distinctly shortened. This is

the state referred to as protanopic vision in the literature of the subject. If, on the other hand, the ferriheme is present in excess of the normal proportion, the region in which the two pigments function jointly would extend further towards the green. In consequence, the regular sequence of colour normally seen between the green and the red would tend to disappear. Ultimately, green and red would merge and be indistinguishable. This is the condition known as deuteranopia. Both in protanopia and in deuteranopia, the rapid change of hue appearing at  $490\text{ m}\mu$  would be observable. In both cases also, the colour progression from the green to the red would be unobservable, but for wholly different reasons.

Protoanomalous and deuteranomalous vision may be considered as intermediate states between the normal condition and the conditions of protanopia and deuteranopia respectively. The luminosity and hue discrimination curves determined by observation for these anomalous types of vision are in satisfactory accord with the results to be expected on that basis.

1. "The Perception of Light and Colour and the Physiology of Vision," Memoir No. 125 of the Raman Research Institute, *Proc. Ind. Acad. Sci.*, 1960, 52, 255.

## SECOND-ORDER EFFECTS IN ELASTICITY, PLASTICITY AND FLUID DYNAMICS\*

THE importance of non-linear continuum mechanics in bridging the gulf between microscopic and macroscopic theories of matter is now well recognized. The large amount of work produced in different fields had to be examined scientifically and placed on sound foundations. This was attempted at the International symposium in Haifa. It was found that fluids like Reiner-Rivlin which obey the constitutive equation

$$r = A_0 + A_1 d + A_2 d^2 \quad (A)$$

do not exist,  $r$  being the stress-tensors,  $d$  is the rate of strain velocity tensor and  $A$ 's functions of the invariants of  $d$ . In like manner the need for generalized strain measures, suggested by Seth and Reiner, was felt. Concepts like that of simple fluids and transition phenomenon were also put forward.

Three types of non-linearity—parametrical, deformational and tensorial—were discussed in all the 41 papers presented at the symposium.

Elasticity claimed 14 papers, plasticity 8 papers and fluid dynamics 19 papers.

Professor Reiner of Technion, Haifa, was the Chairman of the symposium. After his opening address, Truesdell gave a general lecture on the growth and development of constitutive equations, which for the most part have remained of theoretical interest on account of their complicated nature.

Seth, Reiner and Karni gave generalized measures of deformation. Seth showed that the non-linear measure

$$s = (1 - ne)^{-1/n} \quad (B)$$

includes all the known measures. Its use does away with the need of using increased number of coefficients of the medium and indicates the directions in which results may be extended to conform to experimental data.

Odqvist gave a critical review of existing theories of creep rupture.

The meeting ended with three survey lectures. Seth gave the one on elasticity, Drucker on plasticity and Oldroyd on fluid dynamics.

B. R. SETH.

\*International symposium held under the auspices of the International Union of Theoretical and Applied Mechanics at Haifa, Israel, April 21-29, 1962.



## STRUCTURE OF A NEW CARBIDE OF TITANIUM

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IT seems likely that a new carbide, a bicarbide of titanium exists. The compound, interesting in that it has a very small unit cell, a simple cubic cell of side  $3.13 \text{ \AA}$ , was discovered while the authors had occasion to examine the powder pictures of a material obtained when ethylene was treated with titanium tetrachloride at a fairly high temperature in a sealed quartz tube. The resultant product contained several phases of differing density of range 1.5 to 2.5. Powder photographs were taken of each fraction. The fractions of density less than 1.8 gave a set of sharp lines that could be indexed on the basis of a simple cubic cell of size  $3.13 \text{ \AA}$ . The fraction had an admixture of free carbon and its true composition was difficult to assess, though the titanium content was 35%. Consequently, any relevant information had to be inferred from the powder photograph. The observed spacings and visually estimated intensities are given in Table I.

TABLE I  
Intensity data for  $\text{TiC}_2$ . Simple cubic with  
 $a = 3.13 \text{ \AA}$

$\sin^2\theta$	Index	Intensities	
		Observed	Calculated
0.061	100	10	4533
0.120	110	15	8161
0.181	111	4	1836
0.242	200	2	1061
0.301	210	8	2223
0.360	211	6	1132
0.481	220	3	370
0.540	221	6	1527
0.598	310	4	1031
0.662	311	4	771
..	222	..	91
0.779	320	3	918
0.836	321	6	1503

Clearly the compound is not titanium because few elements have the simple cubic system. It is not  $\text{TiC}$ , which is of the NaCl type, face-centred cubic of size  $4.32 \text{ \AA}$  with four molecules per cell. (In fact,  $\text{TiC}$  was detected in the fractions with higher density and higher titanium content.) The smallness of the cell allows not more than one molecule per cell and no structure could be proposed with one

Ti atom and one C atom per unit cell, which could explain the absence of the reflection 222. The mode of preparation of the substance demands that it is a compound of only titanium and carbon. It is reasonable to expect that the compound is  $\text{TiC}_2$  if it cannot be  $\text{TiC}$ . Higher carbides are of course not possible because the cell is too small for them.

A structure based on one molecule per simple cubic unit cell of size  $3.13 \text{ \AA}$  could be proposed provided a statistical arrangement of the  $\text{C}_2$  group was allowed. There is only one  $\text{C}_2$  group but the symmetry is cubic, so that it is necessary for the  $\text{C}_2$  group to lie parallel to the three cubic axes with equal probability in different unit cells. The origin is chosen midway between the two carbon atoms and the titanium atom is placed at  $(1/2, 1/2, 1/2)$ . The carbon atom is defined by a parameter  $u$  in the set of co-ordinates  $(u, 0, 0; -u, 0, 0); (0, u, 0; 0, -u, 0); (0, 0, u; 0, 0, -u)$ . In a particular cell, the two carbon atoms would have one of these three pairs of co-ordinates. However, because of the statistical arrangement, there would be equal probability for all the three pairs, and consequently, the intensities were calculated assuming  $1/3$  of a carbon atom to be present at each of the six positions. The best agreement was found by trial and error to occur at  $u = 0.25$ . The intensities calculated for this value of  $u$  are also given in Table I and there is good agreement with observation. The agreement, however, is only qualitative. No quantitative measurements have been made in view of the heavy fluorescent radiation from titanium. Further, the compound itself is very unstable and breaks down in the presence of moisture. Because of these, a more detailed investigation seems difficult to undertake.

However, even the qualitative data are sufficient to bring out the correctness of the structure. The strongest of the calculated set are the strongest of the measured ones and the weakest, 222, is not at all observed on the photograph. On the basis of the above structure the Ti-C distance comes out to be  $2.34 \text{ \AA}$  as against  $2.2 \text{ \AA}$  for  $\text{TiC}$ . The C-C distance is found to be  $1.56 \text{ \AA}$ . The occurrence of such  $\text{C}_2$  groups in  $\text{CaC}_2$  is well known where the C-C distance within the group is  $1.53 \text{ \AA}$ . In view of these considerations, it is quite possible the higher carbide  $\text{TiC}_2$  exists and has a

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statistical structure. The main interest is that this compound is one of the very few that are known to have such a small cubic unit cell. There exist some elements which have smaller cells than the one under discussion but to the best of the authors' knowledge there is no other compound as such. It is not proposed to continue the investigation any further and this publication is just to point out the existence of this compound.

The experimental work in this investigation was done by one of the authors (G. N. R.), at the Indian Institute of Science, Bangalore. The authors are grateful to Professor M. R. A. Rao of the Chemistry Department of this Institute for providing the material for study.

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## THE GLYCOPROTEIN FRACTIONS IN CEREBRAL TISSUES FROM VARIOUS ANIMALS

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IN one of our previous reports<sup>1</sup> the method for the isolation of glycoproteins from brain tissues has been described. On the basis of the results obtained from the present investigations, besides other studies, a comparison between the levels of the individual glycoprotein fractions in various animals was carried out. These fractions remain in colloidal dispersion in physiological solution and are constant at pH 4.40. In the present report the results obtained have been given.

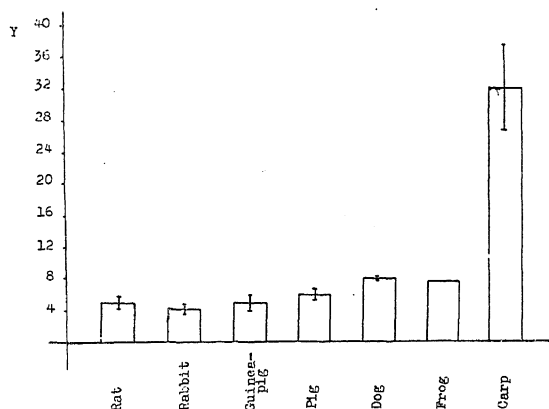


FIG. 1. Protein-bound hexose in brain tissue (Fraction soluble at pH 4.40). Y = mgm. % bound hexose/100 gm. fresh brain tissue.

The experiments were carried out on two types of domestic animals (pig, dog), three kinds of laboratory animals (rat, guinea-pig, rabbit) and on two kinds of cold-blooded animals (frog, carp). The bigger animals were killed

by exsanguination from the cervical artery or by means of a heart cannula (pig, dog, rabbit). The freshly autopsied brains were thoroughly washed, stripped of investing meninges and then parts of the hemispheres containing equal amounts of white and grey matter investigated. The little animals (rat, guinea-pig, frog, carp) were killed by decapitation and the whole brains were investigated. In the case of carps and frogs 3, 5 and 11 brains, respectively, had to be combined because the quantity of a single brain specimen was too small.

The homogenized brain tissues were diluted with physiological solution (for 1 gm. tissue 20 ml. physiological solution), centrifuged and the supernatant brought to pH  $4.40 \pm 0.05$  with acetate buffer. At this pH the precipitation of the protective colloids takes place. The material is centrifuged again after which the clear supernatant is obtained in which the total amount of proteins (method by Kjeldahl) and the bound hexose may be determined. The bound hexose was determined by the orcin method which was devised by Stary *et al.*<sup>2</sup> when investigating the cerebrospinal fluids.<sup>3</sup> The determinations were always carried out in duplicate or triplicate. In the preceding paper<sup>1</sup> the procedure and the method have been described in detail.

The results have been summarized in Table I. In the warm-blooded animals and in the frogs the values of bound hexose are on the whole well balanced and range between 4 and 8 mgm./100 gm. fresh brain tissue. That means that it forms 0.7 to 1% of the weight of the proteins

which under the conditions of the experiment (in the physiological solution at pH 4.40) remain in colloidal dispersion. Thus, these proteins are not rich in glycoprotein fractions.

TABLE I

Total amount of proteins and the protein-bound hexose in the brain tissue fraction (soluble at pH 4.40) of various animals

		Bound hexose in mgm. for 100 gm. fresh tissue			Total proteins in mgm. for 100 gm. fresh tissue		
		No. of animals	Mean value	Mean quadratic deviation	No. of animals	Mean value	Mean quadratic deviation
Rat	..	28	5.07	0.75	17	650	50
Guinea-pig	..	10	4.96	1.04	10	724	74
Rabbit	..	13	4.29	0.62	13	580	112
Dog	..	2	8.0	0.20	2	676	101
Pig	..	10	5.85	0.75	11	548	30
Frog	..	11*	7.6	..	11	530	..
Carp	..	23†	32.0	5.37	14‡	552	153

% = per cent. of bound hexose of the total protein;  
\* = 1 determination, † = 7 determinations, ‡ = 4 determinations.

On the contrary, we found an approximately sixfold amount of bound hexose in carps. When taking into consideration that the amount of total proteins in brain tissues of carps does not differ from that of the other animals under investigation then bound hexose forms almost 5% to 6% of the protein value. Consequently, the brain of the carp must be fairly rich in glycoprotein fractions.

The higher mean quadratic deviations both for bound hexose and the total proteins in carps are due to the fact that in 3 carps which we investigated in December the values were considerably higher than in those which were investigated in spring. It is assumed that the same dependence on the season is being dealt with as could be proved for the glycoproteins of the blood serum in frogs (subsequently again in cold-blooded animals).<sup>4</sup>

The problem is under investigation in order to clarify these findings.

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## TELSTAR—THE U.S. COMMUNICATIONS SATELLITE

WHAT was indeed a major break-through in global communications were accomplished when on July 10, 1962 the U.S. successfully launched into orbit the first active communications satellite, *Telstar*, from the launching base Cape Canaveral in Florida, by means of a three-stage 90-foot Thor-Delta rocket.

The satellite is circling the earth every 157.8 minutes at speeds ranging from 18,830 m.p.h. at farthest point to 11,220 m.p.h. at nearest. The orbit ranges from 3,502 to 593 miles from the earth and is inclined at 44.7° to the equator. The satellite itself is a hollow aluminium and magnesium sphere, 34.5 inches in diameter and 170 lb. in weight, covered with 3,600 solar battery cells which collect energy from the sun and store it in 19 nickel-cadmium cell batteries.

Unlike the passive Echo satellite, a spatial reflector which is used to bounce signals over long distance, *Telstar* is a working satellite. It contains a miniature communications receiver, an amplifier, and a retransmitting device.

On its fifth orbit, just 15 hours after *Telstar* was launched, the first telephone conversation

was exchanged, the message being relayed through *Telstar* "as easily and clearly as over land." Then followed transmission of still-pictures and "live" television demonstrations.

The working process is as follows: Ground antenna, following the satellite across the sky, transmits radio signals on a frequency of 6390 Mc. with a power of about 2 kw. The signals cover a frequency band of 25 Mc. broad enough to carry one television channel, 600 one-way voice channels or 60 simultaneous two-way telephone conversations. The signals are amplified 10,000 million times by the satellite and retransmitted on a frequency of 4170 Mc. and a power of 2½ watts. By the time the signals reach the earth they have a power of only a billionth part of a watt or less. It is therefore necessary to have a large highly sensitive antenna on the ground, like the 177-ft. horn antenna at Andover, to catch the faint signals. At the ground stations the signals are amplified once again, and transmitted out over the usual communications circuits, such as land lines and micro-wave relay networks,

## SOME VEGETABLE DRUG RESOURCES OF LADAKH (LITTLE TIBET)—PART I

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**L**ITTLE is known about the vegetable resources of the Ladakh region, which is also known as little Tibet; this is mainly because the area is cut off, and travelling is difficult due to lack of good communication system. However, it was only during the past few years that a small expedition could be organized to survey this area.

Ladakh frontier district is situated in the extreme north of India and lies towards the east of the Kashmir valley touching the borders of Tibet in the north-east, China in the north and the U.S.S.R., in the north-west. The district comprises the inner dry region of the northern Himalayas which is surrounded on all sides by very high mountains; the result is that moisture-laden winds fail to enter into this region. The total annual precipitation which is estimated to be less than 8 cm. is mostly in the form of snow in the months of November to February and rain in the months of August and September. The climate is extremely dry. For the most part the country consists of bare crags and granite dust, with vast arid tablelands of high elevation. It is a land where there are no forests or pastures, and the appearance is of brown barren mountains. There is hardly any place in this region with an altitude of less than 2,400 m. above m.s.l. The height of its mountain peaks ranges from 5,200 m. to more than 7,600 m. above m.s.l.

The country is composed of stupendous mountain ranges without parallel anywhere else in the world. The Karakoram form the northern boundary of Ladakh with passes at elevations exceeding 5,000 m. above m.s.l. To the south of the Karakoram lies the Ladakh range. South of this and cut off from its main chain by the river Indus lies the Zaskar range. Thus surveying the country from south to north, three mountain chains are met with which contain two great valleys the Indus and the Shyok—the true basin of Ladakh.

Botanical survey of parts of Ladakh range, area surrounding Leh, Stak, Tikse, Stakna, Gangles, Khardung la, Khardung-Rong, Satti, Khalsar, Tirit, and Nubra valley was carried out. To enter into Nubra valley the party crossed Khardung la, a pass lying at 5,602 m. (18,380 ft.) and explored the river valley right up to Saichen glacier—the source of Nubra river. On return the party took a detour and surveyed

a part of the area lying around Shyok river, the route followed was: Satti to Rongdu, Agham, Digar, Sobu la and return to Leh.

During the course of this survey it was found that valleys and hills of Ladakh have some important medicinal plants, one of these being *Ephedra*. There are two species of *Ephedra*, viz., *Ephedra gerardiana* Wall. and *E. intermedia* Schrenk & Mey. which grow in great abundance throughout the vast region and enormous quantities of the two species are available. *E. gerardiana* is a herbaceous perennial used as a substitute for the official species *E. equisetina* Bunge and *E. sinica* Stapf which yield the alkaloids ephedrine and pseudoephedrine for which there is considerable demand in the Indian Market.<sup>1</sup> *E. gerardiana* from Ladakh was found to contain 1% of total alkaloids which is up to the required standard of Indian Pharmacopœia.<sup>2</sup> The possibility of supply of this herb from Ladakh is worthy of consideration now that good road communications are being developed. *E. intermedia* is rather poor in its alkaloidal content and its extraction may not be economical.

A few species containing solanaceous alkaloids, i.e., hyoscyamine group of alkaloids are also found in this region. The chief among these is *Physochlaina præalta* (Don) Miers which was found to be growing plentifully in a state of nature all over this region at altitudes varying between 2,800 m. and 4,200 m. above m.s.l. Locally the plant is popularly known as *Langtang*. The growth of the species is profuse at altitudes between 3,000 m. and 3,600 m. above m.s.l. and it particularly flourishes in waste lands near the habitations, on borders of fields and under the boulders. Samples of the plant collected at the flowering stage were found to possess a high alkaloidal content; leaves, contain 1.02% and roots, 0.64% total alkaloids calculated as hyoscyamine; hyoscyne is also present to the extent of 0.01%. This plant can form an excellent source for the indigenous manufacture of atropine if sufficient quantities of the plant material are made available. It is estimated that 20–25 tons of dried leaves of *Physochlaina* can be collected every year from the whole of this district and a sustained annual supply of more than 15 tons of herb and half as much as roots could be maintained.

Since there is a great demand for hyoscyamine group of alkaloids it would be necessary to supplement the natural sources with cultivated material. The possibilities of cultivating *P. præalta* on a commercial scale at various places in Ladakh were also investigated. It would appear that the prospects of cultivating the drug are good and that cultivation can easily be carried out at suitable places by the local people who have shown keen interest in such a project.

Attempts were also made to cultivate the plant in the Kashmir valley. The seeds were collected from various places in Ladakh and sown in Srinagar, 1,525 m. above m.s.l. and Sanasar, 2,200 m. above m.s.l. Seed germination rate was only 25% but could be improved to 58% by pretreating the seed with commercial sulphuric acid for 15 seconds. The plants from both treated and untreated seeds remained stunted and did not attain their full size as in their natural habitat. Further, though these plants bore flowers, seed formation was absent. This was mostly due to the pollens and ovules remaining shrivelled. The alkaloidal content of the plants raised in various nurseries was low as compared to the plants occurring in nature. First year plants contained 0.24% total alkaloids. The alkaloidal content however improved with the age of the plant. It appears that by acclimatisation, domestication, and application of suitable cultural practices, the alkaloidal content may improve. Further experimental work in this connection is in progress. It may be suggested that the drug may be processed in that region, instead that it be carried over long distances for the purpose. The crushed drug is exhausted with alcohol and the solvent recovered by distillation, the solvent is finally removed from the extract by distillation under vacuum. The extract thus obtained may be marketed, this concentrated alkaloidal extract is purchased by the pharmaceutical concerns and is used in various preparations, or may be processed further for the manufacture of atropine, hyoscyamine sulphate, etc.

Cases of poisoning in horses due to *P. præalta* have occurred. However, still it is a usual practice in Ladakh to dry the aerial portions of the plant and use it as a winter fodder for goats, sheep, etc. Some plants develop black sclerotia inside the hollow stem, which are highly poisonous. The seeds are used by the local people as vermifuge to expel round-worms, and as an emetic in bilious attacks. The leaves are applied to boils.

*Hyoscyamus niger* Linn. and *H. pusilus* Linn. are two other solanaceous species occurring in this region. Samples were collected for chemical analysis and it was found that the former species contains appreciable quantities of hyoscyamine group of alkaloids, falling within the British Pharmacopœial<sup>3</sup> standard, however the distribution of this species is more or less sporadic and not very large quantities of the drug can be obtained unless cultivated. Occurrence of *H. pusilus* is rather frequent but unfortunately active contents are not satisfactory, but attempts are being made to improve these by cultural practices. It has, however, been observed that unlike *Physochlaina præalta*, *H. pusilus* shows normal growth at as low an altitude as that of 300 m. above m.s.l. at Jammu and bears fruits and seeds normally. Of the other solanaceous plants, mention may be made of *Lycium ruthenicum* Murr. which is found growing very commonly in the Karakoram at an altitude of about 3,700 m. above m.s.l. The species was however conspicuously absent from the area of Ladakh range surveyed. Samples of the plant were chemically examined but were found to contain only small percentage of hyscyamine group of alkaloids. It is quite possible that seasonal variation of the alkaloidal content occurs both in *Hyoscyamus pusilus* and *Lycium ruthenicum* which is under study.

A number of species of *Artemisia* such as *A. sieversiana* Ehrh. ex Willd., *A. desertorum* Spreng., *A. moorcroftiana* Wall., *A. laciniata* Willd., *A. falconeri* C. B. Clarke, and *A. stracheyi* Hook. f. & Thoms. ex C.B.C. also grow in abundance practically throughout Ladakh. Samples of various species were collected for assay but none showed appreciable quantities of santonin. However, a good number of the species contain appreciable quantities of essential oils. Of the other sparsely distributed species of *Artemisia* mention may be made of *A. tournefortiana* Reichb., *A. sacrorum* Ledeb. and *A. minor* Jacquem. ex Bess. Of these *A. sacrorum* contains about 1.0% of essential oil.

*Ferula narthex* Boiss. and *F. jäschkeana* Vatke. occur commonly in Ladakh up to an altitude of about 4,000 m. above m.s.l. An oleo-gum-resin, the asafoetida of commerce, is obtained by incision from the living rhizomes and roots of *F. narthex* (and also *F. foetida* Regel). Indigenous plants of *F. narthex* give a fairly good yield of the gum-resin which forms a good substitute for the imported commodity coming to us via the Persian gulf port and

Bombay. Collection of asafœtida from Ladakh is not done systematically, though the local people here and there collect and sell it; and out of ignorance a lot of foreign organic matter finds its way into the drug, but otherwise the quality of asafœtida from Ladakh is considered very good.

There are a number of other medicinal plants commonly met with in the area which are widely used against a number of diseases in indigenous medicine. The following list gives some important species commonly growing in Ladakh which can be collected in sufficiently large quantities.

1. *Arundo donax* Linn. is a tall robust grass found plentifully throughout the country, particularly in the Nubra valley. It is used as a field barrier by the local population. The rhizome of this grass is valued as a diuretic and is said to stimulate menstrual flow and diminish the secretion of milk.

2. *Capparis spinosa* Linn. is a much branched spinous scandent perennial herbaceous plant with long trailing branches growing frequently in Ladakh range. The root bark is valued as a tonic, expectorant and anthelmintic and also used in splenic disorders and rheumatism.

3. *Gentiana* species such as *G. tenella* Fries, *G. pedicellata* Wall., *G. decumbens* Linn. f. and *G. moorcoftiana* Wall. grow in shady and moist situations. Out of these species roots of *G. tenella* and *G. decumbens* are commonly used as tonic, febrifuge and stomachic.

4. *Peganum harmala* Linn. is another shrub which occurs commonly throughout the area. The plant shows profuse bushy growth, the seeds are valued locally as anthelmintic and alterative and are also used as an insectifuge, bactericide and abortifacient.

5. *Potentilla fruticosa* Linn., a cushioned, low perennial shrubby plant, is commonly found at high altitudes of about 4,600 m. above m.s.l. The leaves of this plant are used as a substitute for tea.

6. *Salsola kali* Linn. which is used as an anthelmintic commonly grows in sandy localities.

7. *Thalictrum minus* Linn. is found fairly commonly in Ladakh range at an altitude of about 3,500 m. above m.s.l. The rhizomes of this plant are employed in various ophthalmic diseases.

The fern flora of this area is rather poor, *Cystopteris fragilis* Benth. was found to occur

to a limited extent along moist and shady situations. A decoction of the rhizomes is used as an anthelmintic in the form of an enema by the local population.

*Essential oil-bearing plants.*—Quite a number of aromatic plants also grow commonly in this area, the more important being:—

*Rosa webbiana* Wall. is a large shrub found in abundance all over Ladakh. The plant flowers profusely in summer and the flowers have a particularly sweet fragrant smell. Production of otto of roses could be developed as a small cottage industry if the flowers are systematically exploited.

*Chenopodium botrys* Linn. is a small branched strongly aromatic herb growing commonly in sandy soils. The plant contains an essential oil, which is an anthelmintic.

*Mentha longifolia* Huds. and *Perovskia abrotanoides* Karel are two aromatic members of Labiatae family which grow very commonly. The former species grows in shady and moist situations along watercourses, but the latter is found more commonly in dry and sandy localities. *Mentha longifolia* is commonly used as a carminative and stimulant by the local people. Work on essential oil from *Perovskia abrotanoides* is in progress.

*Carum bulbocastanum* Koch (Umbelliferae) is also frequently found along watercourses. The fruits of this herbaceous plant are used for the same purpose as those of *C. carvi* Linn. and also contain an essential oil.

*Conclusions.*—From the above, it appears that the arid zone of Ladakh is fairly rich in medicinal plants, though their number is not very large. However, a good number of useful medicinal plants are available which may be exploited. Because the area is remote and inaccessible at present, on account of lack of communications, economic exploitation of many of these plants is not being done. A network of roads is, however, being rapidly developed and this will enable systematic development of the herbal wealth of this region.

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## LETTERS TO THE EDITOR

### ON THE EXCITATION TEMPERATURE OF UNDER-GLYCERINE SPARK BY BAND SPECTROSCOPIC STUDY

THE electric sparks in inorganic liquids and vapours have been widely used for studying the formation of free radicals in chemical changes.<sup>1,2</sup> Under the conditions of spark in liquids, thermal decomposition is the most important factor which leads to splitting of the complex molecules into simpler free radicals. The derivation of the temperature from a knowledge of the intensity distribution in the band systems excited in such sparks<sup>3,4</sup> enables us to understand the mechanism of the formation of the free radicals. In the present investigation, the effective temperature of the spark between carbon electrodes under glycerine is determined by a study of the vibrational intensity distribution of  $C_2$  (Swan) bands.

A condensed spark is struck between carbon electrodes in glycerine which flows under a constant pressure head through a glass tube. The continuous flow of glycerine ensures that the spark is always struck in fresh glycerine, prevents heating of the liquid and the small amounts of colloidal particles of carbon which are formed are carried away by the flowing glycerine. The gaseous products resulting from the spark escape through the open upper end of the flow tube. The spark conditions were varied in two ways: (i) by varying the high tension voltage and (ii) by changing the condensation in measured steps. The stabilization of the main spark was done by an auxiliary tandem spark in air between copper electrodes. The spectrum of the spark is recorded on Kodak P 1200 plates using a Hilger constant deviation spectrograph with a dispersion ranging from 18.4 Å per mm. at  $\lambda 4365$  to 76.6 Å per mm. at  $\lambda 6191$ . The photographic photometry using a step-slit and a standard lamp is employed to determine the intensities of the bands of the  $C_2$  (Swan) system in the  $v''$ -progressions with  $v' = 0, 1, 2, 3, 4$ .

Assuming the invariance of the electronic transition moment with internuclear distance, we have the following relation connecting the intensity  $I$  of a band with temperature  $T$  (abs.) under Maxwell-Boltzmann distribution of vibrational energy:

$$\sum_{v''} \frac{1}{v'^4} = AN_{v'} = AN_0' \cdot e^{-E_{v'}/kT}$$

where  $A$  is a constant and other symbols have their usual meaning. With the measured values of  $I$ , a graphical plot of  $\log_{10} \sum \frac{1}{v'^4}$  against the vibrational energy  $E_{v'}$  was made and it gave a straight line. The slope of it yielded an 'effective temperature' in the range 5300° K. to 9800° K., under varied parameters of voltage and capacity. The spark temperature as a function of voltage and capacity is shown graphically in Fig. 1 (a), (b).

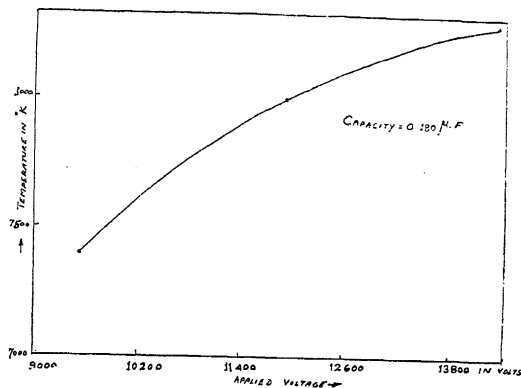


FIG. 1 a. Temperature as a Function of Applied Voltage.

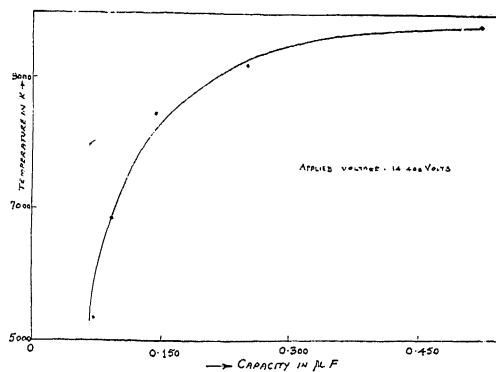


FIG. 1 b. Temperature as a Function of Capacity.

The range of temperature found agrees well with the values obtained by other investigators. For instance, Wilson's<sup>5</sup> measurement in the case of OH bands in under-water spark is 5000° K., while Johnson and Tawde's<sup>3</sup> estimate for spark under glycerine is 6100° K. It is found that there is an increase in the temperature of the spark with capacity or voltage

increase and this is so, because the increased duration of the oscillating current imparts a higher temperature to the electrodes.<sup>6</sup> The results seem to suggest that the mode of supply of energy to the spark is also a contributory factor in deciding the spark temperatures.

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## PHOTOELASTIC PROPERTIES OF BARIUM FLUORIDE

BARIUM FLUORIDE is now available in the form of single crystals of large size, grown synthetically from melts. Of late barium fluoride is finding its place, among other things, in the design of optical components of spectrographs. Hence a study of its photoelastic behaviour is of considerable importance. Data on some important physical properties of barium fluoride have been obtained by Ballard, Combes and Mc Carthy.<sup>1</sup>

For the measurement of photoelastic properties of barium fluoride a Babinet compensator was used. Since the crystal cleaves easily along its (111) face, it required great care in the cutting and grinding of the crystal to obtain various orientations. While performing the experiment the stress could not be increased beyond 0.5 kgm. per sq. mm. and several attempts at increasing the stress beyond this value resulted only in the cleavage of the specimen. Table I gives the orientations and sizes of crystal prisms used in the experiment.

The values of  $q$ 's obtained are as follows:

$$q_{11} - q_{12} = -2.934 \times 10^{-13} \text{ cgs units}$$

$$q_{44} = 1.06 \times 10^{-13} \text{ cgs units}$$

These experimental results confirm Mueller's<sup>2</sup> prediction that for barium fluoride ( $q_{11} - q_{12}$ ) must be negative and  $q_{44}$  positive. Thus barium fluoride behaves like a negative uniaxial crystal when stressed along a cube axis and as a positive uniaxial crystal when stressed along a cube diagonal.

TABLE I

Specimen No.	Length		Breadth		Thickness	
	cm.	Parallel to	cm.	Parallel to	cm.	Parallel to
1	0.776	[111]	0.597	[211]	0.510	[011]
2	0.600	[001]	0.520	[110]	0.365	[110]
3	0.723	[001]	0.700	[110]	0.365	[110]

Recently the elastic constants of barium fluoride have been measured by Bergmann<sup>3</sup> and the values for  $c_{11}$ ,  $c_{12}$  and  $c_{44}$  obtained by him are:

$$c_{11} = 9.01 \times 10^{11} \text{ dynes/cm.}^2; c_{12} = 4.03 \times 10^{11} \text{ dynes/cm.}^2; c_{44} = 2.49 \times 10^{11} \text{ dynes/cm.}^2$$

These values confirm an earlier observation on the Young's modulus of barium fluoride by Ballard *et al.* From the above values of  $c_{11}$ ,  $c_{12}$  and  $c_{44}$ , the values of ( $p_{11} - p_{12}$ ) and  $p_{44}$  were calculated to be:

$$(p_{11} - p_{12}) = -14.61 \times 10^{-2} \text{ cgs units}$$

$$p_{44} = 2.639 \times 10^{-2} \text{ cgs units.}$$

All the above values have been obtained with sodium yellow light and at room temperature. Detailed investigations of the variation of birefringence with wavelength are under progress.

The authors' grateful thanks are due to Messrs. Harshaw Chemicals Ltd., Synthetic Crystals Division, Cleveland, Ohio, U.S.A., for their gift of the crystal blanks and to Mr. S. Raghunathan, Principal of Nizam College, Hyderabad, for giving the necessary facilities for work in the college.

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# UREY-BRADLEY FORCE FIELD- PLANAR $XY_3$ MOLECULES

THE normal vibrations of planar  $XY_3$  type of molecules have been investigated by several authors,<sup>1-5</sup> using different types of potential force fields. An attempt has been made here to calculate the potential constants for  $BI_3$ ,  $AlCl_3$  and  $PO_3^{=}$  on the basis of the Urey-Bradley type of potential force field and the results are reported in this note.

The plane  $XY_3$  molecules have the symmetry  $D_{3h}$ . According to the selection rules, there are  $a_1' + a_2'' + 2e_1'$  types of vibration. The  $a_2''$  class is due to the out of plane vibration and this co-ordinate is not included in the potential function.

The Urey-Bradley potential function in the general form was taken and the F matrix elements<sup>5</sup> were obtained in the usual way. The G-matrix follows directly from the method of Wilson.<sup>6</sup> The F and G-matrix elements were used for the evaluation of force constants of the molecules.

The observed frequencies<sup>7,8</sup> and the values of force constants for  $BI_3$ ,  $AlCl_3$  and  $PO_3^{=}$  are given in Table I.

TABLE I  
Observed frequencies and force constants of  
plane  $XY_3$  molecules

Molecule or Ion	Obs. frequencies ( $cm^{-1}$ )				Force constants ( $10^5$ dynes/cm.)		
	$a_1'$	$a_2''$	$e_1'$		K	H	F
	$\sigma_1$	$\sigma_2$	$\sigma_3$	$\sigma_4$			
$BI_3$	.. 190	336	704	100	1.937	0.164	0.249
$AlCl_3$	.. 541	..	808	348	3.855	0.298	0.747
$PO_3^{=}$	.. 946	523	1014	425	4.808	0.095	1.193

K—Stretching force constant; H—Bending force constant; F—Repulsion force constant.

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## ON THE CHARACTERISATION OF TRIMETHYLNAPHTHALENES

THE standard practice to identify naphthalenic compounds obtained in the dehydrogenation of natural products is to determine the m.p. and the mixed m.p. of their picrates or similar adducts with authentic samples. The limitations of this method are apparent from the work of Ruzicka and Ehmann,<sup>1</sup> and have been once again brought to notice by Ried and Bodem.<sup>2</sup>

Recently<sup>3</sup> we obtained a naphthalenic compound in the dehydrogenation of a nimbin derivative. The melting points of the picrate and the trinitrobenzene adduct of the compound, as well as its U.V. spectrum indicated it to be either 1.2.5 or 1.4.5 trimethylnaphthalene.<sup>3</sup> However the mixed m.p. with the picrates of the authentic samples of 1.2.5 or 1.4.5 trimethylnaphthalene did not prove to be of help to make a decision; m.p. of the picrate of the dehydrogenation compound (A)=140–142°; m.p. of the picrate of 1.2.5 trimethylnaphthalene (B)=139–141°; m.p. of the picrate of 1.4.5 trimethylnaphthalene (C)=144–146°; mixed m.p. of A and B = 138–140°; mixed m.p. of A and C = 141–144°.

Final decision that our compound was indeed 1.2.5 trimethylnaphthalene was made from the fact that its I.R. spectrum (in solution) was identical with that of 1.2.5 trimethylnaphthalene and not the other.

Although in dehydrogenation experiments in the terpenoid field 1.2.5 trimethylnaphthalene is the most likely product to be expected, since several terpenoids with biogenetically modified carbon skeletons are now being brought to light, we feel that characterisation of naphthalenic compounds, in these experiments, solely on the basis of m.p. and mixed m.p. of their picrates may not be entirely reliable.

We thank Dr. Walter Ried for authentic samples of 1.2.5 and 1.4.5 trimethylnaphthalenes. Department of Chemistry, N. S. NARASIMHAN. University of Poona, Poona-7, June 29, 1962.

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### MEASUREMENT OF PARTIAL BIREFRINGENCE OF PLEOCHROIC MINERALS

THE only method available by which the partial birefringences can be computed is by the determination of the refractive indices (Johannsen<sup>1</sup>), and by the use of the Universal stage as described by Naidu.<sup>2</sup> There is no reference in current literature regarding a method of determining the partial birefringence for routine petrographic work.

The present author has attempted to suggest a method of determining the partial birefringences by the method of determining accurately the 'Pleochroic Scheme' of the mineral either by classical or conoscopic method.<sup>3</sup> By this way the colours are accurately correlated with the vibration directions. When once the colour corresponding to the respective vibration direction is established, the orientation of the section is also established. For example, let us take a pleochroic mineral like hypersthene. The pleochroic scheme seen in hypersthene is as follows: X = Pink, Y = Yellow, Z = Green. In this hypersthene a section showing pleochroism from pink to yellow will therefore have XY orientation; a section showing pleochroism from yellow to green will have YZ orientation; a section showing pleochroism from pink to green will have XZ orientation. Hence, if we measure the birefringence on a section showing pleochroism from pink to green, we will obtain the value  $(\gamma - \alpha)$ ; and sections showing pleochroism from pink to yellow will give the value  $(\beta - \alpha)$ ; and sections showing pleochroism from yellow to green will give the value  $(\gamma - \beta)$ .

The accuracy of this method lies in the accurate determination of the vibration directions and correlation of the colours with the vibration directions. The accuracy obtained by this method lies within the error obtained by the refractive indices method, and is quite good enough for ordinary routine petrographic work, where rapid identification of the mineral is sought. But the main drawback of this method is that it is applicable only to pleochroic minerals, and as such leaves a void in the case of the determination of partial birefringences of non-pleochroic minerals.

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### USE OF Cu-PAN COMPLEX FOR THE SPECTROPHOTOMETRIC ESTIMATION OF CALCIUM

THE present communication reports a new spectrophotometric method developed by the authors employing the characteristic absorption of copper-1-(2-Pyridylazo)-2-Naphthol (PAN) complex as an indicator for the estimation of calcium.

Since  $\text{Cu}^{++}$  forms 1:1 complex with PAN<sup>1</sup> with a lower stability constant than the  $\text{Cu}^{++}$ -EDTA complex, this can be successfully employed for the titration of metals with EDTA. The principle of the present method is that EDTA combines first with  $\text{Ca}^{++}$  ions and then with  $\text{Cu}^{++}$  ions, when a mixture of calcium and copper in presence of a slight excess of PAN is titrated with EDTA. This results in decrease in the intensity of colour at  $\lambda = 550 \text{ m}\mu$  characteristic of  $\text{Cu}^{++}$ -PAN complex after the end point of  $\text{Ca}^{++}$  (Fig. 1). It is however to be noted that  $\text{Ca}^{++}$  does not form any complex with PAN.

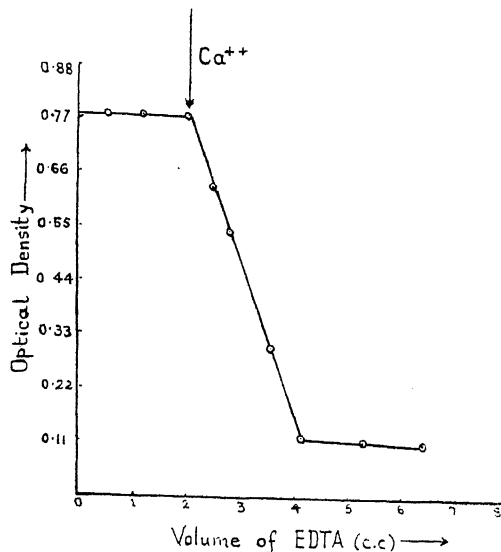


FIG. 1

Stock solution of PAN (Judex) was prepared in redistilled methanol. Solutions of calcium chloride (B.D.H., Analar), copper sulphate (B.D.H. Analar), EDTA (E, Merck) were prepared in doubly distilled water and esti-

1. Johannsen, A., *Manual of Petrographic Methods*, McGraw-Hill Book Company, Inc., New York, 1918, p. 369.

mated by the usual analytical methods. Walpole acetate buffer of pH = 5.0 was employed.

Aliquots of standard copper and calcium solutions were pipetted into a calibrated 50 ml. flask, to which calculated amounts of PAN and buffer solutions were added. Increasing amounts of EDTA were then added and the total volume was made up to 50 ml. by the addition of redistilled methanol, giving thereby about 50% methanol-water solution. A measured sample of these solutions was taken in the absorption cell and absorbancy was measured with a Carl Zeiss spectrophotometer.

Table I gives a typical set of data of the amount of  $\text{Ca}^{++}$  taken and  $\text{Ca}^{++}$  found.

TABLE I  
Estimation of calcium with EDTA

Solution No.	Indicator concn. $\text{Cu}^{++}$ mg.	$\text{Ca}^{++}$ taken mg.	$\text{Ca}^{++}$ found mg.	Error %
1	4.994	1.47	1.46	0.54
2	"	2.94	2.93	0.34
3	"	4.41	4.39	0.45
4	"	5.88	5.84	0.69
5	2.497	1.47	1.40	0.49
6	"	2.94	2.90	0.13
7	"	4.41	4.37	0.79
8	"	5.88	5.85	0.51

It is seen that the results so obtained agree closely within  $\pm 1\%$ . This method has the additional advantage of estimating  $\text{Ca}^{++}$  at a lower pH value.

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### ALUMINIZED ALKYDS

THE oil modified alkyds constitute one of the most important class of resins used in the field of coatings. These resins are versatile, in that the coating compositions based on them are known for their excellent durability, adhesion, flexibility, colour retention, etc. However, there are certain defects associated with the above resins and these include poor water and chemical resistance, poor through drying in thicker

films and the soft nature of the films at higher oil lengths. The elimination of these drawbacks should further boost up their utility and in this connection mention has been made of the reaction of certain metal-active compounds, such as aluminium alkoxides and titanium esters, with alkyd resins in some patented literature. Hence work was undertaken to investigate this phase of alkyd technology.

The present work in progress is confined to study the reactions of aluminium alkoxides with alkyd resins. The aluminium alkoxides, viz., *n*-butoxide and isopropoxide were prepared by Young's method.<sup>1</sup> Attempts were made to react the alkoxides with different types of alkyd resins at elevated temperatures, but it was found very difficult to control the reactions and in all the cases the products gelled. The alkoxides were then stabilized using a keto-enol tautomer, viz., ethyl acetoacetate by the method suggested by Weiss.<sup>2</sup> Attempts to react these enolised alkoxides with preformed commercial alkyds at elevated temperatures also proved futile, while the cold-cut mixtures of these alkyds and enolised aluminium alkoxides showed poor storage stability, as evidenced by the increase in viscosity.

Hence to standardise the conditions, special, high hydroxyl linseed-glycerol alkyds in four different oil-lengths were prepared. Each oil-length alkyd was further studied in detail with three different hydroxyl values. A 50% solution of enolised aluminium butoxide in white spirit was used at four different levels, viz., 25%, 50%, 75% and 100% of the theoretical quantity calculated on the basis of the hydroxyl values of the alkyd resins. All the reactions were carried out at 150° C. and in a suitable solvent medium to a pre-gelation stage. The time of reaction varied with the oil length.

The aluminized alkyds dry fast. They require less of cobalt drier and with a concentration of 0.02% Co, an aluminized linseed-glycerol alkyd dries as fast as a linseed-pentaerythritol alkyd with a cobalt drier concentration of 0.05% Co. Besides the 'through' drying in thicker films is much better than the conventional linseed-glycerol alkyds as evidenced by a higher rocker hardness. Improvements in the scratch hardness and water resistance are also observed. Work is under progress to study the weathering characteristics of the synthetic enamels prepared from the different aluminized alkyds and also to study the effect of different alkoxides and keto-enol tautomers on the film properties of the aluminized alkyds.

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### DETECTION OF METANIL YELLOW IN FOOD PRODUCTS

METANIL YELLOW, the sodium salt of metanilyl azodiphenylamine, is a non-edible coal-tar dye, extensively used in India for colouring food products, in contravention of the Prevention of Food Adulteration Act. A method is described for the accurate identification of metanil yellow in foods from its  $R_f$  value and light absorption based on a separation procedure for food colours reported earlier.<sup>1</sup>

An aqueous extract of the dye, free from other material, is prepared by any suitable conventional method. Products like asafoetida and dhalls are first extracted with water, starchy foods like biscuits with 70% alcohol containing 2 to 3% ammonia, and sweets rich in oils and fats with water acidified with hydrochloric acid. Non-alcoholic liquid preparations do not require this preliminary step. If alcohol is used for extraction, it is removed by evaporation and the residue is dissolved in water. The aqueous extract is strongly acidified with hydrochloric acid and extracted with amyl alcohol. From the amyl alcohol, the dye is re-extracted with water and the solution concentrated by evaporation.

The solution is spotted on a strip of Whatman No. 1 Filter Paper side by side with a spot of pure metanil yellow solution and chromatographed by the ascending technique using isobutanol 2 ml., ethylenediamine hydrate 1.6 ml., water to 100 ml., as the developing solvent. If the solution contains more than one dye, a number of spots are run on a wider strip, and after development, each zone is cut out, eluted with water and re-chromatographed.  $R_f$  values obtained in this manner are more reliable than those from a mixed solution. The  $R_f$  value of metanil yellow in the system described is 0.19.

On exposure to hydrochloric acid fumes, the spot turns pink if it is metanil yellow. This is a test for the dye.

The dye is eluted from the chromatogram with water or with N/10 hydrochloric acid and the eluate is used for spectrophotometric examination. Pure metanil yellow for reference can

be prepared by chromatographing 20 ml. of a 1% solution of the commercial dye in 90% ethanol containing 1% ammonia on a column of alumina, eluting the pure dye with the same solvent, evaporating the eluate to a low bulk on a water-bath and drying it over sulphuric acid in a vacuum desiccator.

Metanil yellow has an absorption peak at  $432 m\mu$  in neutral solution and at  $528 m\mu$  in N/10 hydrochloric acid. A Beckman DU Spectrophotometer was used for the measurement of extinction.

Govt. Analyst's Lab., P. S. NATARAJA SARMA.  
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### A RAPID METHOD OF ESTIMATION OF ASCORBIC ACID IN TISSUES

POLK *et al.*<sup>1</sup> described a method for the rapid determination of ascorbic acid in urine. This method is a modification of the method of Roe and Kuether.<sup>2</sup> Besides using 2, 6-dichlorophenolindophenol (DCPP) in place of norit as the oxidising agent, incubation was done by them in boiling water for 10 minutes,<sup>3</sup> at  $37^\circ \text{C}$ .<sup>2</sup>

The method described here has been developed on the basis of those of Polk *et al.*<sup>1</sup> and of Bessey *et al.*,<sup>4</sup> and compares favourably with any other relevant methods in sensitivity and rapidity. The materials used are:

(1) 5% trichloroacetic acid (TCA); (2) 2.2% 2, 4-dinitrophenyl hydrazine (DNPH) in 10 N sulphuric acid; (3) 5% thiourea; (4) 0.6%  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ ; (5) 65% sulphuric acid and (6) standard ascorbic acid (AA) solution in 5% TCA.

Two different series of determinations were carried out. In the first series six different concentrations ( $5 \mu\text{g.}$  to  $50 \mu\text{g.}$  per ml.) of AA-solutions were employed. In the second series, five points from  $1 \mu\text{g.}$  to  $16 \mu\text{g./ml.}$  solutions were taken. To 1 ml. of AA-solution was added 1 ml. of the reagent (90 parts of DNPH, 5 parts of thiourea and 5 parts of  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ ) followed by incubation in a boiling water-bath for 10 minutes. The mixtures were then cooled by immersing them in an ice-bath. Next, previously cooled (in ice-bath) 65% sulphuric acid was carefully added (to avoid rise of temperature) to make a final volume of 12 ml. and 6 ml. in case of first and second series of mixtures respectively. After waiting for 30 minutes at room temperature ( $25^\circ \text{C}$ . approximately) the

tubes were read at 540 m $\mu$  in the Spectronic 20 (Bausch and Lomb). The tubes were read also in the Klett Summerson photoelectric colorimeter using green filter (No. 54). Almost identical readings for optical density were obtained for the same concentration of AA-standards irrespective of the apparatus used.

Figure 1 represents graphically the results obtained. Curve A (Fig. 1) refers to the values obtained with the first series of AA-concentrations, using the present method. It is found, however, that contrary to what has been reported by Polk *et al.* the slope of the Curve A differs considerably from that of B, which represents the values obtained with similar concentrations of the AA-standard following the method of Bessey *et al.*<sup>4</sup> Curve C refers to the values obtained with the second series of concentrations of AA-solution. It appears that the slope of this curve is still better than that of A.

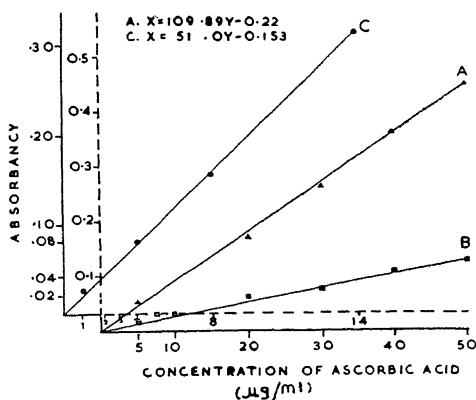


FIG. 1. Calibration curve for ascorbic acid determination: Curve A refers to the determination having the final volume at 12 ml. and C to that at 6 ml. before reading of the tubes.

Table 1 includes the results obtained in a number of experiments for recovery of AA-standards added to liver and ovarian tissues, which were homogenized in distilled water such that 1 ml. of the homogenate corresponds to 10 mg. of wet tissue. To 2 ml. of homogenate equal volumes of AA-standards were added followed immediately by centrifugation. 1 ml. of the supernatant was taken and its AA-contents were determined following the present method. It is found that the recovery has been a little above hundred per cent. in all cases except two.

According to the present method the amount of the reagent (DNPH + thiourea + copper sulphate) added per millilitre of the test solution was in the ratio of 1:1 whereas it was 1:4 according to others.<sup>1-4</sup> It is apparent from the

TABLE I  
Recovery of ascorbic acid standards added to tissue homogenates. Concentration of ascorbic acid ( $\mu$ g. per ml.) in:

10 mg. of tissue	Added standards	Tissue + standard (observed)	% recovery
A liver	6.8	5	12.4
"	6.8	10	18.2
"	6.8	20	27.0
"	6.8	30	37.9
"	6.8	40	47.2
"	6.8	50	57.6
ovary	8.6	10	18.8
B liver	1.2	1	2.5
"	1.2	4	4.8
ovary	6.5	8	14.54
"	8.6	10	17.9

A—Final volume before reading was 12 ml. B—Final volume before reading was 6 ml.

N.B.:—The variations in the ascorbic acid content of the tissues might be due to the difference in age of the animals from which tissues were taken.

slopes of Curves A and B (Fig. 1) that the reaction leading to the formation of osazones was not complete when the proportion of the reagent to the test solution was 1:4 and the mixture was incubated at 37° C. for 3 hours. That the deepening of the colour that is finally developed is not due to charring by sulphuric acid of the reagent was verified by submitting the highest of AA-standards to this procedure, omitting the inclusion of DNPH (but not 10 N sulphuric acid) in the preparation of the reagent.

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#### UNKNOWN BOUND OXALATE IN THE LEAVES OF BATHUA (CHENOPodium ALBUM L.)

It is generally known that oxalates occur in plants in water-soluble forms and as the insoluble calcium oxalate.<sup>1,2</sup> Srivastava and Krishnan<sup>3</sup> have shown that the leaves of spinach, *Amaranth*, *her* and *Alocasia* contain sufficient

TABLE I  
Oxalates in the leaves of Bathua (*Chenopodium album* L.)  
(Percentage composition expressed on dry weight basis)

Sample No.	Maturity of plant		Moisture	Calcium	Total oxalate	Soluble oxalate	Insoluble oxalates			
							Total	Bound with calcium	Bound in unknown form	
									% of dry leaf	% of total insoluble oxalates
1	Unflowered	..	81.5	1.85	14.16	5.01	9.15	4.16	4.99	54.53
2	"	..	83.1	1.73	15.97	6.62	9.35	3.89	5.46	58.39
3	Just flowered	..	85.2	2.36	18.31	7.77	10.54	5.31	5.23	49.62
4	Flowered	..	84.7	2.25	18.89	7.77	11.12	5.06	6.06	54.49
5	"	..	85.5	2.18	19.79	8.55	11.24	4.91	6.33	56.31
6	Seeded	..	82.2	3.65	30.03	3.09	26.94	8.21	18.73	69.52

Samples 1 to 6 are arranged in increasing order of maturity. All analyses were done in duplicate.

calcium to account for all of the insoluble oxalate as calcium oxalate. In the course of our work we observed that the entire calcium content of the leaves of the common vegetable, *Bathua* (*Chenopodium album* L.), could account for only 45% of the insoluble oxalates. As this observation was unusual, the analyses were repeated using different samples in different stages of maturity. Total and water-soluble oxalates were estimated by the method of Baker.<sup>4</sup> Calcium was estimated on dilute hydrochloric acid extract<sup>5</sup> of ash by precipitating as oxalate, washing with dilute ammonia and titrating against 0.01 N potassium permanganate.

It can be seen from Table I that with maturity both water-soluble and water-insoluble oxalates increased till the flowered stage. Subsequently, there was a decrease in the soluble oxalate content and an enormous increase in the insoluble oxalate content (27% on dry weight basis). The total oxalate content of the *Bathua* leaves as usually consumed varied from 14-20%. The comparable values reported for spinach<sup>6,7</sup> and Amaranth (*Amaranthus gangeticus*) are 10-15.5% and 9-12.7% respectively. It appears therefore that amongst all the common green vegetables, leaves of *Bathua* contain the highest percentage of total oxalic acid. This plant, which has been described in ancient Indian literature<sup>8</sup> as one of the five nutritious green vegetables, is therefore not nutritious as far as calcium utilization is concerned.

The major part (55-70%) of the insoluble oxalate existed in some unknown bound form not identical with calcium oxalate. This unknown form of the insoluble oxalate constituted a substantial part of the

leaf, increasing slowly in the beginning and rapidly towards the end. Further work on the nature of the insoluble oxalate is in progress.

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#### SYNTHESIS OF VITAMIN B<sub>12</sub> BY SOIL BACTERIA

THE relative distribution of the micro-organisms synthesizing vitamin B<sub>12</sub> in the rhizosphere of crops and in the control soil has not been studied so far in this country and was therefore undertaken with wheat (*Triticum vulgare*), cowpea (*Vigna catabang*) and berseem (*Trifolium alexandrinum*) and the results obtained are discussed below.

Using a non-selective soil extract agar medium<sup>1</sup> bacterial isolates were obtained from the rhizosphere and control (non-rhizosphere) soils of the three crops raised under conditions of manure and no manure. The isolates were grouped into five nutritional groups,<sup>1</sup> viz.,

(i) Basal medium group ('B' group), (ii) amino-acid group ('A' group), (iii) growth factor medium without B<sub>12</sub> ('GF' group) (iv) growth factor medium with B<sub>12</sub> ('GFB<sub>12</sub>' group) and (v) yeast soil extract medium ('YS' group). Of these the first two groups were chosen for study. The amount of B<sub>12</sub> synthesized by the isolates in these two groups was determined following the official U.S.P., method\* using *Lactobacillus leichmanii* A.T.C.C. No. 4797 as the test organism. Influence of rhizosphere and the nature of the crop on the incidence of synthesis is given in Table I. The results indicate that in all the three crops studied, the percentage of synthesizers of B<sub>12</sub> was markedly higher than non-synthesizers and the crops could be ranked as cowpea > berseem > wheat. A large percentage of synthesizers in wheat and berseem belong to the rhizosphere, while in respect to cowpea they were equally divided between the rhizosphere and control.

TABLE I  
Rhizosphere effect and crop on the incidence  
of synthesizers of vitamin B<sub>12</sub>

		Wheat	Cowpea	Berseem
Synthesizers %	..	69.2	92.9	72.1
Non-synthesizers %	..	30.8	7.1	27.9
Synthesizers from rhizosphere %	..	65.7	50.0	64.5
Synthesizers from control %	..	33.3	50.0	35.5

Synthesis of B<sub>12</sub> expressed in mμg./ml. as influenced by rhizosphere and manuring is given in Table II.

TABLE II  
Rhizosphere effect and manure on the average  
synthesis of B<sub>12</sub> in mμg./ml.

Crop	Manure		No. Manure	
	R	C	R	C
Wheat	.. 9.2	7.4	5.8	3.2
Cowpea	.. 10.4	10.0	5.7	8.5
Berseem	.. 31.8	25.7	31.5	19.3

(R = Rhizosphere; C = Control)

Manuring in general has favourably influenced B<sub>12</sub> synthesis. In wheat and berseem rhizosphere isolates even from no manure treatment were better synthesizers of B<sub>12</sub> than their corresponding control isolates. The average quantity of B<sub>12</sub> synthesized was the highest with isolates from berseem and lowest with wheat.

The synthesizers were broadly divided into

two groups: (i) rich synthesizers—synthesizing 15 mμg./ml. and more and (ii) poor synthesizers—synthesizing less than 15 mμg./ml. The relative distribution of these two groups in the three crops studied is given in Table III. It may be seen from this table that the rich synthesizers are berseem > cowpea > wheat. Table IV gives the distribution of the synthesizers of B<sub>12</sub> in the amino-acid group and basal medium group. A high percentage of bacteria synthesizing appreciable amounts of B<sub>12</sub> was observed in the amino-acid group.

TABLE III  
Relative incidence of poor and rich synthesizers  
of vitamin B<sub>12</sub>

Crop	Poor %	Rich %
Wheat	.. 65.3	3.8
Cowpea	.. 74.9	17.8
Berseem	.. 7.0	51.2

Poor = Less than 15 mμ g./ml.

Rich = Above 15 mμ g./ml.

TABLE IV  
Relative percentage distribution of synthesizers  
and non-synthesizers of vitamin B<sub>12</sub> in  
'B' and 'A' nutritional groups

Crop	Synthesizers		Non-synthesizers	
	B	A	B	A
Wheat	.. 50.0	85.7	50.0	14.3
Cowpea	.. 83.7	91.7	6.2	8.3
Berseem	.. 50.0	100.0	50.0	Nil

B = Basal medium nutritional group.

A = Amino-acid nutritional group.

The general features of B<sub>12</sub> synthesis by soil bacteria as observed here are:

(i) Soil bacteria with a marked capacity to synthesize vitamin B<sub>12</sub> are associated with the rhizosphere of legumes.

(ii) Of the nutritional groups of bacteria the amino-acid group has a pronounced capacity for synthesis of B<sub>12</sub>.

(iii) Manuring, in general, has favourably influenced the synthesis of this vitamin.

These results seem to suggest that the success of legume rotation in improving soil fertility is partly due to the capacity of legumes to support the specific microflora that synthesize appreciable amounts of vitamin B<sub>12</sub> for the other organisms that participate in soil fertility processes like nitrogen fixation.

Our sincere thanks are due to Dr. B. P. Pal, Director, for his keen interest in the work and to Dr. C. Dakshinamurti, for helpful suggestions. One of us (A. S.) thanks the Indian Council of

\* *Methods of Vitamin Assay*, Second Edition. Prepared and edited by The Association of Vitamin Chemists, Inc. (Interscience Pub., Inc., New York), 1951.

Agricultural Research, New Delhi, for the award of a Senior Fellowship.

A. SANKARAM.

W. V. B. SUNDARA RAO.

Division of Soil Science and

Agricultural Chemistry,

I.A.R.I., New Delhi-12,

March 3, 1962.

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### OBSERVATIONS ON THE ENDOCRINE GLANDS OF *MUSCA NEBULO*

THE ring gland of the larvæ of cyclorrhaphous diptera has been described by various authors.<sup>1-6</sup> The metamorphosis of the fly and the ring gland has been studied by Day<sup>4</sup> in the *Drosophila*. The endocrine system of some adult diptera has been described by a few authors<sup>6-9</sup> and their role in the physiology of reproduction has been investigated by Thompson,<sup>7</sup> Day,<sup>4</sup> Vogt<sup>3</sup> and Bodenstein.<sup>5</sup> A detailed study of this gland in the larvæ and adult from the point of view of its structure and probable function in the Indian housefly *Musca domestica nebulo* and the salient points emerging out of these studies are enumerated below.

The ring gland in the mature larvæ lies dorsal and anterior to the brain. The anterior part of the ring is formed by the corpus allatum, the posterior median part by the corpus cardiacum and the sides by the peritracheal glands. The ring gland is innervated by a branch of recurrent nerve and a pair of stout cardiac nerves. The nuclei of the corpus allatum are small and their cell boundaries are generally not distinct. The corpus cardiacum consists of both chromophile and chromophobe cells. The peritracheæ are large and their nuclei are much bigger. The neurosecretory cells in the brain consist of 4 groups of cells. In the earlier larval stages the corpus allatum is very prominent while in the older larvæ the peritracheal glands increase greatly in size.

During pupal development the peritracheal glands are hystolised and the ring gland penetrates into the prothorax. The anterior median part of the ring becomes the corpus allatum and the posterior neutral region the corpus cardiacum. The chromophile cells of the corpus cardiacum appear to be in a highly mature state in the late pupal stage.

The endocrine system of the adult fly consists of the neurosecretory cells in the central

system and the corpus cardiacum allatum complex. In the pars-intercerebralis of the brain there are 30-32 neurosecretory cells. Of these 14-16 are A cells and the remaining B cells. The axons of these cells run along the anterior margin of the brain and emerge from the floor of the supra-oesophageal ganglion. It then unites with the recurrent nerve and runs backwards to enter the corpus cardiacum. The latter organ lies in the anterior region of the prothorax ventral to the aorta. In the mature female the corpus cardiacum is seen with neurosecretory colloids. The corpus allatum lies dorsal to the aorta and is connected to the corpus cardiacum by a pair of allatic nerves. In the newly emerged female corpus cardiacum is small while in mature female it is fairly enlarged.



FIGS. 1-2. Fig. 1. Brain and ring gland of the late 3rd stage larva (whole mount). A—Ring gland, B—Cerebral trachea, C—Brain. Fig. 2. Horizontal section of the ring gland. A—Corpus allatum, B—Cells of the peritracheal gland, C—Corpus cardiacum.

Extirpation of the corpus allatum from the newly emerged female prevents growth only. The egg chambers do not grow beyond the yolk deposition stage. Transplantation of the corpus allatum from the mature females or males, stimulates ovary development in the



allactomised females. Transplantation of the ring glands with the brain also stimulates egg maturation. During growth, accessory glands do not seem to be dependent on the corpus allatum hormones. The median neurosecretory cells are also necessary for the development of the ovaries since the extirpation of these cells prevent egg maturation. The ovaries in such flies develop on transplantation of the median regions of the brain, taken from the mature females. The accessory glands of the flies deprived of median neurosecretory cells are small and do not contain the secretory material.

These studies confirm and extend the observations of the previous workers.

We are thankful to Dr. K. Ganapati, Director, for giving us encouragement and facilities and to Shri N. E. Vad, Mr. G. C. Chaturvedi and Mr. Mathews for the help rendered from time to time.

Haffkine Institute,  
Bombay, March 26, 1962.

P. J. DEORAS.  
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### CUTANEOUS SENSE-ORGAN IN *OPHIOCEPHALUS STRIATUS* BLOCH.

STUDIES on the Cutaneous sense-organs of fishes have been reported by several workers,<sup>2,4-9</sup> but not much work has been done on the fishes of Indian waters. Bhatti<sup>1</sup> and Dorairaj<sup>3</sup> have reported the occurrence of sense-organs in the skin of scaleless fishes. The present note is a report on the occurrence of a sense organ in the skin of a scaled fish, *Ophiocephalus striatus* Bloch.

The sense-organs in *O. striatus* were found at the sides of and very close to the lateral line canals but restricted only to the anterior part of the body of the fish. Each organ consists of a saccular depression of the external skin, the wall of which is composed of specialised cells smaller in size than those of the general epidermal layer. Since the entire organ is as thick as the epidermis like the epidermis, it rests on the scale below and has no papillae or

other supporting structures. In an epidermis  $20\mu$  in thickness, the base of a sense-organ at its widest part is  $60\mu$  across and the apex or pore  $20\mu$  in diameter. The pore is bordered by thin lip-like extensions of the superficial layer of the epidermal cells. Two types of cells, the sensory cells and the supporting cells, can be distinguished in each organ.

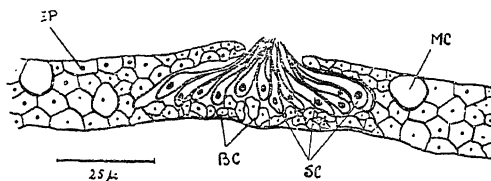


FIG. 1. Sense-organ in the epidermis of *O. striatus*. EP=Epidermis. MC=Mucous cell. SC=Sensory cells. BC=Basal or Supporting cells.

1. The sensory cells are arranged in a single layer. In an organ which measures  $60\mu$  at its widest part, there are 14 sensory cells. Each cell is slender and elongated with a broader base and narrower outer end. The nucleus is situated nearer the base. The outer narrow ends of the cells are continued as delicate protoplasmic hairs or cilia-like structures, which project through the pores.

2. The supporting cells are small epidermal cells at the base of the organ and at the same level as the basal layers of the epidermis. They are more numerous than the sensory cells and are arranged irregularly in one or two rows. Each cell is rounded or irregular with a prominent nucleus at the centre.

Though only a few fishes have been studied, it is remarkable that there is a paucity of the number of types of sense-organs met with in fishes. Pit Organs ("nerve-hillocks"), and Gusto-receptors are the only types of sense-organs described so far. The sense-organs in *O. striatus* resemble the Gusto-receptors in structure, though like the Pit Organs, they are found only in the anterior part of the body and on either side of the lateral line. Their location in *Ophiocephalus* on either side of the lateral line need not justify their being described as "accessory lateral sensory organs",<sup>4,5,7-9</sup> for being "accessory" is a qualification relating to function than location. Proprioceptors as well as stretch receptors located in muscles and tendons which can perceive vibrations have been described in some animals, though there is no record of such subcutaneous sense-organs in fishes. In the face of the variety of gross and detailed structure of skin receptors and in the absence of evidence of the occurrence of

proprioceptors and stretch receptors in the fish, one should be careful in ascribing functions to any organ.

Dijkgraaf (1933) has found evidence of sense-organs capable of perceiving contact stimuli in certain blind fish, which orient in a stream when they touch the bottom and receive frictional stimuli. It is possible that receptors such as have been found in *Ophiocephalus* and which have also been described in *Rita rita* and *Macrones* as Gusto-receptors, because of structural similarities with taste buds, may receive chemical stimuli conveyed by streams of water.

I am grateful to Professor C. P. Gnanamuthu, Director, for his valuable guidance and to Dr. S. Krishnaswamy for his encouragement.

Zoological Research Laboratory, B. S. VASU.  
University of Madras,  
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#### CYTOCHEMICAL INVESTIGATIONS OF HEPATOPANCREATIC CELLS IN *ORCHESTIA GAMMARELLA PALLAS*

THE sand-hopper, *Orchestia gammarella* Pallas, occurs abundantly among the decaying weeds at high water-marks on the seashore. They are also found, occasionally, several miles away from the sea.

Among the crustaceans, the anatomy and histology of the hepatopancreatic cæca has been studied by Huie (1901)<sup>1</sup> and Patrick (1926)<sup>2</sup> in *Ligia oceanica*. However, no work has so far been done on the structure and functions of the hepatic cells of the ventral cæca of any amphipod.

The alimentary canal of *Orchestia* consists of the foregut, the midgut and the hindgut. From the floor of the anterior part of the midgut, where it joins the stomach, arise two lateral pouches which extend backward and soon divide into two pairs of ventral hepatopancreatic cæca which are filled with a yellowish oily fluid.

Histologically, each cæcum is composed of four layers of cells, an outer serous membrane, a muscular layer, a fine basement membrane and the innermost epithelium; this last consists of large conical cells projecting conspicuously into the lumen of the cæcum and small wedge-shaped cells. The conical cells are rather irregular in their configurations and sometimes deeply project in the form of dilated bags; they contain many vacuoles of varying sizes. The vacuoles are, occasionally, discharged into the cæcal cavity.

In order to discover the nature of these vacuoles, the ventral cæca of a few *Orchestia* were fixed in a mixture of 1 part 1% osmic acid and 2 parts of Muller's fluid for 48 hours; thoroughly washed in water, and cut into sections—6 microns thick. The sections, after removing the wax, were mounted in canada balsam without further staining. It was found that the vacuoles had taken black stain with osmic acid (Fig. 1) which shows that the

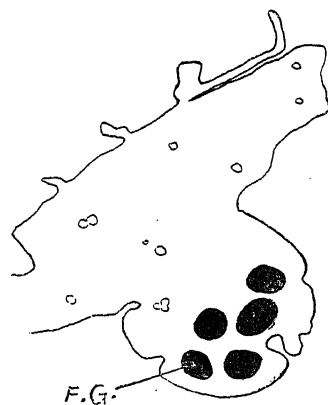


FIG. 1. *Orchestia gammarella*. T.s. of the ventral cæca showing a portion stained with osmic acid. (F.G., Fat globules.)

vacuoles are lipid in nature. The fatty nature of these globules was further confirmed by staining other sections, fixed in Duboscq-Brasil, with Sudan black and counter-staining with Carmalum or with Sudan IV and Hæmalum.

In order to investigate the nature of the small wedge-shaped cells, the cæca, fixed in Carnoy's fixative, were tested for the presence of any glycogen by the Iodine Best's carmine methods, the results in either case were negative.

Cæca from a few animals were fixed in a saturated solution of mercuric chloride and the sections were stained with thionine and toluidine blue, which were mounted in glycerine jelly. These preparations showed that the

wedge-shaped cells are mucous secreting in nature.

The above experiments show that the large cells of the cæca store the food in the form of oil globules, while the small wedge-shaped cells secrete mucin.

Department of Zoology, V. P. AGRAWAL.  
D.A.V. College,  
Muzaffarnagar. (U.P.), February 8, 1962.

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### MODE OF EGG-LAYING IN *HELOPELTIS ANTONII* SIGN. (HEMIPTERA, MIRIDAE)

RECENTLY, the authors (1959) reported an interesting behaviour of the females of certain tingid bugs in depositing eggs within the tissue of their host plants. While studying the biology of the mirid, *Helopeltis antonii* Sign., a similar behaviour of the female in the deposition of eggs was noticed.

Extensive observations on the mode of egg-laying by the mirid on cashewnut plant (*Anacardium occidentale*) both in nature and in the insectory were made. The observations in nature were made with the aid of a hand lens ( $\times 10$ ) and in the insectory under a binocular microscope. The female generally inserted the eggs in the tissue of the fruit-stalks, and occasionally in the apple of the fruit and petiole and midrib of the tender leaves also. The eggs, when laid in the plant tissue, showed their opercular ends in flush with the surface of the twig and two thin white processes (one a little longer than the other) arising from the egg and projecting out of the plant surface.

The behaviour of the female during the process of egg-laying was observed to be almost the same as in the tingid bugs reported earlier. The female began probing by means of the tip of its rostrum and inserted the stylets here and there, and finally, perhaps on finding a suitable site for egg-laying, the stylets were driven deep into the tissue. With the stylets still inside the plant tissue, the bug inclined a little forward so that it could easily bring the tip of the ovipositor into the region of the puncture made by the stylets. Simultaneously the stylets were also withdrawn from the plant tissue. The female began to probe by means of the tip of the ovipositor for the puncture made by the stylets. On finding the puncture the ovipositor was thrust through it and the egg was laid. In case the puncture made by

the stylets was not found, as it sometimes happened, the female did not insert its ovipositor in any other place to lay the egg, and it moved a little further and continued its probing with the rostrum. This process was invariably noticed in all cases.

The significance of the rostrum taking part in selecting a proper oviposition-site is not yet clear. Further observations on the egg-laying habits of the species of bugs that lay eggs in the plant tissue would be interesting, and perhaps throw some light on the significance of this peculiar habit.

Grateful thanks are due to Shri B. Venkoba Rao, Principal, and Dr. M. Puttarudraiah, Government Entomologist, for providing facilities and encouragement.

Agri. College and T. S. THONTADARYA.

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### ON THE OCCURRENCE OF *LONGIDORUS ELONGATUS* (DE MAN, 1876), THORNE AND SWANGER 1936, ASSOCIATED WITH ROOTS OF *TAMARINDUS INDICA* L. IN NORTHERN INDIA

SIDDIQI<sup>1</sup> (1960) reported *Xiphinema citri* Siddiqi, 1959, to be associated with the roots of *Tamarindus indica* L. During the course of investigations of nematodes associated with leguminous plants and trees in Aligarh and adjoining districts a number of parasitic nematodes were isolated. Out of these *Longidorus elongatus* (de Man, 1876), Thorne and Swanger 1936 is reported for the first time from India. This species is known from Asia (Turkey), Europe and North America.<sup>2</sup> It shows considerable range of variation in the food habit and the structure of the body. However, the present specimens conform closely with those described by de Man<sup>3</sup> (1876), Thorne<sup>4</sup> (1939) and Hooper<sup>5</sup> (1961) in the body measurements and general morphology. Major body measurements and a short description of the present material are given here.

*Measurements*: females length = 3.7-4.5 mm. : a = 100-130; b = 9.9-6; c = 86-95 V = 46-48.5%; spear = 78-84  $\mu$ ; spear guiding ring from anterior end = 27-30  $\mu$ .

Body in the form of an open spiral. Lip region rounded, 10.5  $\mu$  in diameter, continuous with the body contour (Fig. 1 A and C).

Buccal spear much attenuated. Spear extension with slight swellings on its base. Spear guiding ring single, located at about  $2\frac{1}{2}$  labial widths from anterior end. Oesophageal bulb elongate,

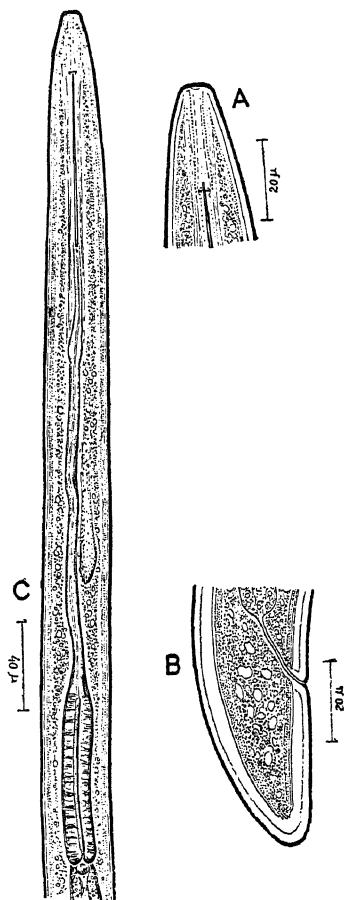


FIG. 1 A-C. Fig. A. Head end of female. Fig. B. Tail end of female. Fig. C. Oesophageal region of female.

cylindrical, about six times as long as wide. Reproductive organs paired, symmetrically opposed; ovaries reflexed. Tail about  $1\frac{1}{2}$  times anal-body-width long tapering to a broadly rounded terminus (Fig. 1 B).

Aligarh Muslim University, JALIL A. SIDDIQI.  
Aligarh, February 15, 1962. ABRAR M. KHAN.  
M. RAFIQ SIDDIQI.

# NOTE ON SOME ARBOREAL TYPE OF COCKROACHES FEEDING ON LACCIFER LACCA KERR.

EXCEPT for a casual mention (Liu Chung Lo, 1957), there is no reference to damage to lac crops being caused by cockroaches. Recently such damage due to arboreal types of cockroaches, namely, (1) *Phyllodromia humbertiana* Sauss, (2) *Ischnoptera fulvastrata* Chop, and (3) *Phyllodromia* sp. has come to light. Some 50% of cockroaches collected from the field during July to August 1957-58 were found to have in their guts chitinised remains of lac larvæ, such as segments of body, legs and antennæ. The alimentary canal also showed presence of lac dye. The exact number of larvæ devoured, however, could not be determined owing to the chewing habit of these predators.

Cockroaches in captivity, artificially fed on lac larvæ developing on twigs, also confirmed the above. Observations at night while the process of eating was going on revealed that these predators split open the resin coat, then pick up and devour the larvæ from inside the lac test: the broken pieces of resin actually fall on the ground leaving a scar mark on the twig, as shown in Fig. 1. It could also be

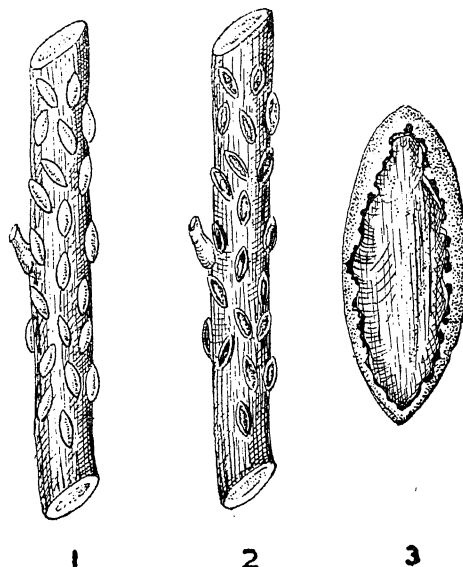


FIG. 1. (1) Lac larvæ (late 1st instar) developing on *B. monosperma* stem. (2) Damaged lac cells. (3) Damaged lac cell (enlarged).

observed that the cockroaches eat up the early instars, mostly the first and the second.

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The damage due to these predators alone in 1957-58, of lac crops on the particular hosts situated near bushes [*Schleichera oleosa* (Lour) Oken, *Butea monosperma* (Lam) Taub] amounted to 36-46%, this being the percentage of larvæ devoured. It could also be observed that bushy hosts, e.g., *Moghania macrophylla* (Syn. *Flemingia congesta*), *Cajanus cajan*, were particularly liable to this type of damage.

Further, the activity of cockroaches being little during the summer, the *Jethwi* and the *Baisakhi* crops usually escape damage due to this cause.

Use of 0.05% BHC (99% active material) wettable powder ensures effective control of these predators.

The author is grateful to Dr. S. Krishnaswami, erstwhile Entomologist of this Institute, for his encouragement and to Dr. A. P. Kapur of Zoological Survey of India, Calcutta, for kindly identifying the specimens and to Sri. B. Mukhopadhyay for his help in the preparation of this note.

Indian Lac Research Institute, N. MAJUMDAR.  
Namkum, Ranchi,  
February 20, 1962.

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#### OCCURRENCE OF *GONOCEPHALUM BILINEATUM* WALK. (COL. TENEBRIONIDAE) IN COFFEE SOILS

*Gonocephalum bilineatum* Walk. and their occurrence in India, Indo Malaya, Papua, Philippines, China and Japan are on record from the collections of British Museum, London. The life-history studies of this species do not appear to have been published. Brief accounts of *Gonocephalum depressum*, *G. hofmannsegii* and *G. plantum* are given in Beeson, 1941; *Forest Insects of India*, pp. 407-08. It is revealed from the accounts given that *G. depressum* lives in the soil, feeding on the rootlets of weeds and crops, particularly of sugarcane, coffee and tobacco. Coleman and Kunhikannan have stated that *G. hofmannsegii* is injurious to roots of crops (*Dept. Agri. Mysore Ent. Bull.* No. 5, 1918).

During October 1961, the presence of *G. bilineatum* Walk. in large numbers was noticed swarming in the soil of Arabica coffee clearing in South Coorg. The beetle, 8-10 mm. long, dull black, usually with adhering soil particles, often swarmed in large numbers when any soil digging operation was undertaken in young

clearings planted with Arabica coffee, mainly during September-October period.

The root injury and sparse root-system in some of the young Arabica coffee clearings may perhaps be attributable to the presence of this species of beetle in large numbers in the soil. However, a detailed study of this species and their economic importance are proposed to be undertaken, during next season.

The writer is indebted to the Director, Commonwealth Institute of Entomology, London, for help in the identification of insect specimens.

The C.C.E., (1943) Ltd., K. C. ANANTH.  
Pollibetta (Coorg),  
January 12, 1962.

#### A NOTE ON *CERCOSPORA CAVARAE* P. AND D. SACCARDO

*Cercospora cavaræ* P. & D. Saccardo (*Sylloge Fungorum*, 1902, 16, 1069) is known to occur on the host genus *Glycyrrhiza*. In March, 1962, the writers collected this fungus on the leaves of *Glycyrrhiza glabra* L. from the Campus, Agricultural Research Institute, Tandojam, West Pakistan, detailed description of which is given below to facilitate identification:

No definite leaf-spots at first, light to dark sooty black fungal growth on the undersurface, later angular or irregular dark brown necrotic lesions which usually coalesce; fruiting amphigenous but chiefly hypophyllous, stromata well developed, light to dark fuliginous brown, composed of rounded cells, globular, usually 17-72  $\mu$  in diameter. Conidiophores in definite fascicles, dense to very dense, in mass fuliginous brown, light olivaceous brown singly, uniform in colour, cylindric or conic, simple to geniculate, unbranched, 0-3-septate, straight to curved, spore scars not visible, tips usually rounded, 10-44  $\times$  3.5-10  $\mu$ .

Conidia obclavate, dirty yellow or light olivaceous brown, multiseptate, mostly 2-5-septate, straight to curved, septa evident, not constricted at the septa, tip rounded, base obconically truncate, 33-87 (143)  $\times$  4.3-8.6 (52.9  $\times$  5.9)  $\mu$ .

From the above it is evident the present collection differs from typical *Cercospora cavaræ* in having a well-developed stromata, and lack of thickened conidial scars at the tip of conidiophores. The conidia are also obclavate than cylindric.

In view of the above-mentioned differences with typical *C. cavaræ*, it is considered worthwhile to bring these variations on record.

The type specimen has been deposited in the Herbarium, Commonwealth Mycological Institute, Kew, England, under Accession No. I.M.I. 86800 b.

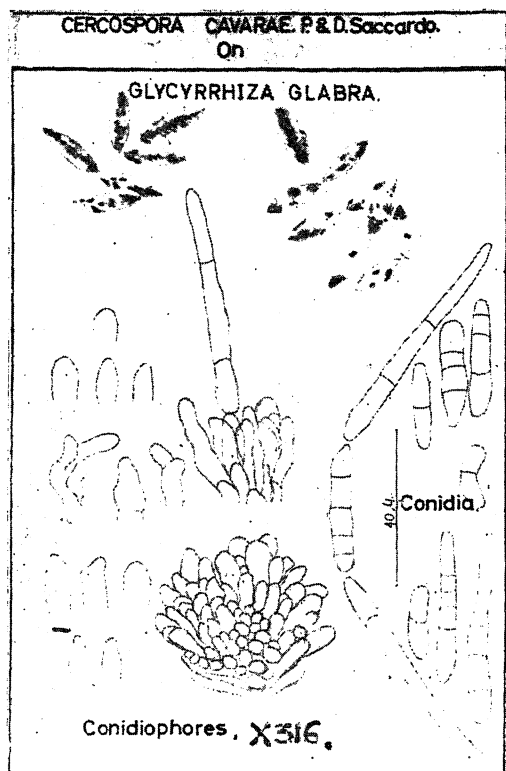


FIG. 1

The writers wish to thank Professor Charles Chupp, and Mr. F. C. Deighton of the C.M.I., Kew, for kindly examining the specimen and giving valuable help.

A. R. I. Tandojam, SHAKIL AHMAD KHAN.  
West Pakistan, M. KAMAL.  
May 29, 1962.

#### EMBRYOLOGY OF *LAGOTIS GLAUCA* GAERTN. (SELAGINACEAE)

THE family Selaginaceae is as yet embryologically uninvestigated. The systematic position and relationships of the family are obscure. It has at various times been grouped in different orders by taxonomists. Benthams and Hooker<sup>1</sup> included the Globulariaceae in the Selaginaceae and placed the family in the Tubiflorae near the Verbenaceae. Engler and Prantl,<sup>2</sup> while recognising the Globulariaceae as a separate family, treated the Selaginaceae as a tribe under the Antirrhinoideae of the Scrophulariaceae. In

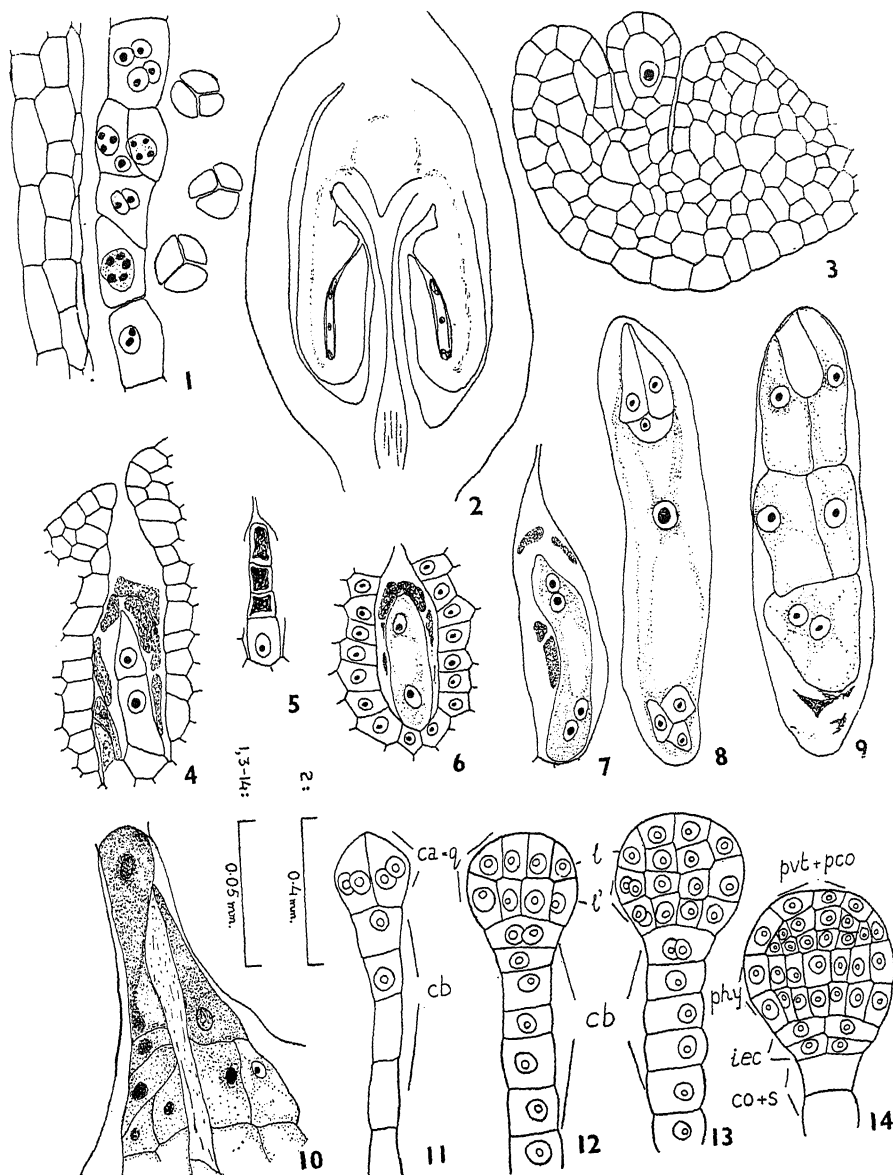
recent years, Hutchinson<sup>3</sup> has considered the family to bear relationship to the Labiatae and has grouped the four families, Myoporaceae, Selaginaceae, Globulariaceae and Labiatae in the order, Lamiales.

The Selaginaceae is a small family consisting of about 120 species, herbs and shrubs, mostly distributed in South Africa, Madagascar and on the mountains of tropical Africa. In India, the family is represented by only one genus, *Lagotis*, which is restricted to the alpine zone of the Himalayas. *Lagotis glauca*, the subject of present study, is a small soft herb with stout rootstock and thick fleshy root fibres. It occurs on alpine slopes at 3,500 to 5,000 metres and is conspicuous by its closely set spikes of dark blue flowers. The flowers are bracteate and strongly zygomorphic with a curved corolla tube. The bracts are persistent and form a hood-like covering for the fruits. There are two stamens with large reniform unilocular anthers. The anther tapetum consists of richly cytoplasmic cells with two to four nuclei (Fig. 1). Nuclear fusions are also seen in these tapetal cells.

The ovary is two-celled with a single ovule, pendulous from the top of each locule (Fig. 2). The ovule, which takes its origin from the top of the loculus, presents a single hypodermal archesporial cell which functions directly as the megaspore mother cell (Fig. 3). The single integument at this stage is short and the nucellus projects above the limits of the integument. The latter soon extends and grows over the nucellus by the time the megaspore mother cell has divided to form the dyads. The nucellar cells covering the dyads breakdown at this stage (Fig. 4). The ovule also gradually undergoes the transformation into the anatropous condition by strong growth on the axial side. The dyad cells undergo further transverse divisions resulting in a linear tetrad of megaspores (Fig. 5). The integument is strongly developed with a narrow micropyle. The functional chalazal megaspore by further nuclear divisions (Figs. 6, 7) forms a Polygonum type of embryo-sac with the egg apparatus, two polar nuclei and three antipodal cells. The polar nuclei fuse to form the secondary nucleus (Fig. 8). An integumentary tape-tum is initiated at the two-nucleate stage of embryo-sac and it becomes very conspicuous at the mature stage of embryo-sac.

Endosperm is cellular and the early divisions conform to the Brunella type. The first division of the primary endosperm nucleus is followed by a transverse wall which divides the embryo-sac into two chambers. Subsequent divisions

are in the longitudinal and transverse planes resulting in the differentiation of the micropylar and the chalazal haustorium of a single binucleate cell



FIGS. 1-14. *Lagotis glauca* Gaertn. Fig. 1. L.s. of part of anther with tapetal cells. Fig. 2. L.s. of ovary. An outline diagram showing position of ovules. Fig. 3. Megaspore mother cell. Fig. 4. Dyad cells. Nucellar cells breaking down. Fig. 5. Tetrad of megaspores. Figs. 6-8. Stages in formation of embryos. Fig. 9. Early endosperm. Fig. 10. Cells of micropylar haustorium lying in micropylar canal. Figs. 11-14. Stages in development of embryo. (ca, apical cell of 2 celled embryo; q, quadrants; cb, basal cell of 2 celled embryo; l, superior octants; l', inferior octants; pvt, stem tip; pco, cotyledonary part; phy, hypocotyledonary part; iec, initials of root epidermis; co, root-cap; s, suspensor).

and chalazal haustoria and a central group of endosperm cells. The micropylar haustorium is cell at the time of their differentiation (Fig. 9). In later stages, the micropylar haustorium

extends into the micropylar canal where its richly cytoplasmic cells are seen (Fig. 10).

The fertilised egg undergoes a transverse division resulting in the apical and basal cells. A tetrad of the  $A_2$  category is formed followed by quadrant formation (Fig. 11). Subsequent growth (Figs. 12-14) and differentiation of the parts in the embryo conform to the Onagrad type of Johansen<sup>4</sup> and belongs to the fourth megarchetype in the first group of the first period in the system of embryogenic classification of Souèges.<sup>5</sup> The suspensor is long, consisting of a single row of cells and lies in the midst of endosperm cells.

This work was done under a scheme of research on "Morphological and Embryological Studies of Certain Families and Genera of Disputed Sytematic Position" financed by the Council of Scientific and Industrial Research and under the guidance of Dr. M. A. Rau, Investigator-in-charge of the scheme. The author wishes to express his gratitude for the award of a Junior Research Fellowship.

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### BOTRYODIPLODIA ROT OF PINEAPPLE (*ANANAS COMOSUS* MERR.)

A STORAGE and transit disease of pineapple was observed in the local market. Isolations from the diseased fruits invariably yielded *Botryodiplodia ananassae* (Sacc.) Pet.<sup>3</sup> Some cultural and pathological investigations were carried out and the results have been summarised in the present note. This is the first record of this disease from India.

In earlier stages of infection, the diseased fruits showed water-soaked appearance of the tissue at the cut end of the stalk and later they assumed dark brown colour. The fungus usually penetrated the vascular core of the fruit and spread into the surrounding pulp tissues and this was followed by a rot of the infected portion. The fructifications (pynidia) of the fungus appeared near the stalk as minute dots under the rind of the fruit. At maturity

they liberated young single-celled hyaline or mature dark bi-celled spores with longitudinal striations.

The pathogen grows rapidly and profusely on potato-dextrose agar medium. The mycelium is greyish-white and gradually turns olive grey and finally changes to dark olive grey. Its width varies from 2 to 6  $\mu$ . Pynidia are gregarious in stromatic masses (Fig. 1), erum-

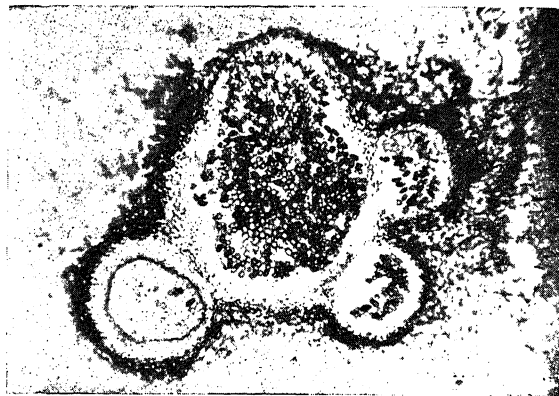


FIG. 1

pent, globoid, with minute ostiole, greyish to black in colour, measuring  $214 \times 183 \mu$  to  $688$  to  $612 \mu$  (average  $464$  to  $367 \mu$ ). Pyniospores ellipsoidal, with episore  $1.5$  to  $2.0 \mu$ , measuring  $20$  to  $25 \mu$  long and  $11$  to  $13 \mu$  broad.

Asthana and Hawker's liquid medium 'A' was used for cultural studies. The effect of different hydrogen-ion concentrations and temperatures on growth and sporulation of the organism are recorded in Table I. The pH for the study of the effect of temperature was adjusted to 5.5.

TABLE I

pH	Dry weight in mg.	Sporulation	Temperature ° C.	Dry weight in mg.	Sporulation
1.5	00.0	..	6	00.0	..
2.5	26.5	Nil	10	00.0	..
3.5	35.7	Poor	20	57.6	Good
4.5	39.7	Fair	25	60.0	Excellent
5.0	44.2	Good	31	50.0	Good
5.5	53.1	Excellent	36	39.9	Nil
6.0	51.4	"	38	22.7	"
6.5	51.1	"	40	00.0	..
7.0	45.6	Good	..	..	..
8.0	39.3	Fair	..	..	..
9.0	39.0	Poor	..	..	..
10.0	34.3	"	..	..	..
11.0	27.8	"	..	..	..

The optimum growth and sporulation of the organism were observed between 5.5 to 6.5 pH.



The growth and sporulation were best at 25° C. There was no growth at 6° C, 10° C. and 40° C. but the fungus could survive even after an exposure to these temperatures for fifteen days. The thermal death point was 59° C.

The fruits were artificially inoculated from the stalk end and they were covered with moist cotton pads. Granger and Horne's method,<sup>2</sup> as well as injury method were tried and controls were also maintained. It was observed that the injured fruits were readily infected. The symptoms were visible after 3 to 4 days of artificial inoculation. Chromatographic analyses of carbohydrates in healthy and diseased fruits after seven days of infection showed that sucrose and maltose (disaccharides) present in healthy tissues were not seen in diseased ones instead only glucose and fructose (monosaccharides) were present in the diseased tissues.

Cross-inoculations were carried out by Granger and Horne's method. Detached fruits of apple (*Malus sylvestris* Mill), peach (*Prunus persica* Batsch), plum (*Prunus domestica* L.), 'nakh' (*Pyrus communis* L.), 'nashpati' (*Pyrus pyrifolia* Nakai var. *culta* Nakai) and banana (*Musa paradisiaca* L.) were found to be susceptible. It is thus clear that the organism is not a very specialized parasite. It was further observed that slight injury with the help of a sterilized needle was essential for successful infection. The infection took place by spraying the spores or by placing the inoculum at the injured region. The spread of the disease was very rapid on peaches (*Prunus persica* Batsch). No infection was, however, observed on fruits of lime (*Citrus aurantifolia* Swingle), mango (*Mangifera indica* L.) and guava (*Psidium guajava* L.).

The authors are thankful to Dr. J. C. F. Hopkins, Director, C. M. I., Kew, for confirming the organism and to Dr. K. S. Bilgrami, for his suggestions. The junior author is grateful to C.S.I.R., for providing Junior Research Fellowship during the tenure of this work.

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February 12, 1962.

### DESYNAPSIS IN *PENNISETUM* *TYPHOIDES* STAPP AND HUBB.

IN a population of over 1,000 individuals of strain T. 55 of *Pennisetum typhoides* maintained in this Division, a single dwarf plant producing numerous tillers (Fig. 1) was noticed. Pollen examination revealed that about 98% of it was non-stainable. Meiosis was studied during microsporogenesis in this plant. Analysis of chromosome pairing at pachytene was rather difficult owing to chromosome stickiness. However, in a few pachytene cells, 1 to 3 bivalents were seen scattered outside the clump of the remaining chromosomes. This suggests that there may be regular pairing at pachytene.

Data on some of the subsequent stages of meiosis are given in Table I. Since the plant had apparently normal pairing at pachytene followed by rapid terminalization of chiasmata, this is a case of desynapsis.

TABLE I

Stage	No. of pollen mother cells with 0-3 pairs/bivalents				P.M.C.s studied	Average number of pairs/bivalents per P.M.C.
	0	1	2	3		
Diplotene ..	18	12	4	4	40	0.95
Diakinesis ..	25	8	5	4	42	0.71
Metaphase I ..	25	4	2	1	35	0.31

In early diplotene, the chromosomes showed a tendency to fall apart while the chiasmata in the few bivalents present were completely terminalized. Towards the late diplotene phase many of the P.M.C.s showed complete desynapsis (Fig. 2). The proportion of such cells progressively increased at diakinesis and metaphase I. The present case of desynapsis falls into 'Medium-strong' group of Prakken.<sup>1</sup>

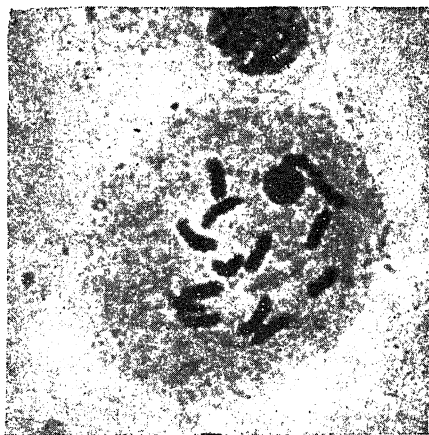
Among the other abnormalities noted in this plant were, (i) poor spindle development, (ii) non-orientation of some of the univalents, (iii) clumping of the chromosomes on the equatorial plates, and (iv) about 5% of the P.M.C.s showing chromosome mosaic, the variation of chromosome number being from 10 to 17. In this species, P.M.C.s showing 12 and 16 chromosomes were observed by Sharma and De<sup>2</sup> who considered them to be due to the non-disjunction of some chromatids at pre-meiotic mitosis. Anaphase I was highly irregular with about 90% of the cells showing different types of abnormalities such as, (i) unequal distribution of chromosomes, (ii) absence of active polar movement, (iii) first

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division restitution nuclei, (iv) formation of dyads, (v) division of univalents, and (vi) varying number of laggards.



1



2

FIGS. 1-2, Fig. 1. *Pennisetum typhoides*. Left: Normal plant; Right: Desynaptic plant. Fig. 2. *Pennisetum typhoides* ( $2n=14$ ). Late diplotene P.M.C. showing complete desynapsis.

In the second division of meiosis, the chromosome behaviour was extremely irregular, about 95% of the cells being abnormal. Among the various irregularities observed were varying number of laggards, irregular distribution and scattering of chromosomes.

The seeds obtained in this plant were of different sizes. Probably they may have dif-

ferent chromosome numbers in which case they may prove to be of interest in breeding.

We are grateful to Dr. M. S. Swaminathan, Head of the Division of Botany of this Institute, for his guidance and encouragement in the present work.

Division of Botany, B. D. PATIL.  
Indian Agricultural (Miss) S. K. VOHRA.  
Research Institute,  
New Delhi-12, February 19, 1962.

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### THE DIPLOID AND THE TETRAPLOID RACE IN *PUPALIA LAPPACEA* JUSS.

THE genus *Pupalia* (Family Amaranthaceae) is represented by seven species distributed widely in Africa, Madagascar and Asia.<sup>1</sup> Three species are reported from India,<sup>2</sup> out of which *P. lappacea* is the most common. It is a highly variable species usually growing under semi-xerophytic conditions in waste lands commonly in the bushes.

Collections of *P. lappacea* secured from five different localities in N.W. India were subjected to a detailed cytological and morphological study, the results of which are reported here. The studies were carried out from the smears of pollen mother cells. Anthers were fixed in Carnoy's solution and later on stained in acetocarmine to which traces of iron had been added.

Preliminary chromosome counts revealed that *P. lappacea* is heterogeneous cytologically. So far two different races, the diploid and the tetraploid, have been found. The diploid and the tetraploid races are very alike in other morphological features, there being only minor quantitative differences. With increase in the chromosome number, the pollen and stomata size increase considerably. In fact pollen size could be used as a means to detect the two races.

In the diploid race 25 bivalents were counted at diakinesis, in a number of pollen mother cells (Fig. 1). The rest of the course of meiosis is normal and results in the production of about 98% fertile pollen grains. Meiotic studies in the tetraploid taxon revealed  $n=50$ . At early metaphase-I, 50 bivalents were clearly discerned (Fig. 2). The chromosomes paired normally into bivalents and no multivalents were seen. At anaphase-I, there were no laggards. The rest of the meiotic course being regular, results in production of Ca. 97% fertile pollen grains.

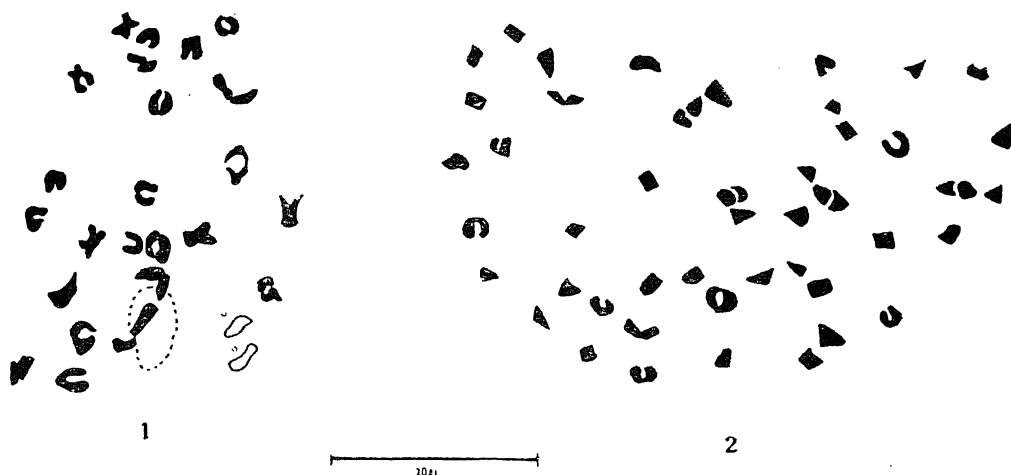
Cytology of *P. lappacea* was investigated earlier by Mehra and Pal<sup>3</sup> who reported the number  $n=50$  in a population from Amritsar. The present is the first report of polyploidy at species level in the genus *Pupalia*. The basic chromosome number of *P. lappacea* is  $X=25$ , which is not in agreement with the known chromosome numbers of other members of the family.<sup>4,5</sup>

The writer would feel grateful to persons who will send him seeds and herbarium specimens of the species from diverse localities.

I am grateful to Prof. K. N. Kaul for guidance and encouragement throughout the course of this investigation.

Botany Laboratory,  
National Botanic Gardens,  
Lucknow, February 21, 1962.

MOHINDER PAL.



FIGS. 1-2. Fig. 1. Diakinesis showing 25 bivalents. One bivalent shows loose pairing of the chromosomes marked 'U'. Fig. 2. Early metaphase-I showing 50 bivalents.

The diploid race of *P. lappacea*, reported here, was collected from Lucknow (North India), where only the diploid form occurs, while collections from four other places in Northern India show the tetraploid form alone. As yet, there is no evidence of their overlapping distribution or hybridization. Thus the marked feature of their distribution pattern is their exclusive nature. The exact significance of the distribution of these races in different parts of the country is under study. It is not unlikely that there is some correlation between polyploidy and geographical distribution of this species.

Stebbins<sup>6</sup> has classified various types of polyploids and has laid down certain diagnostic features for each type. Based on the cytological grounds mentioned by him, the tetraploid race of *P. lappacea*, reported here, appears to be allopolyploid, since multivalents are entirely absent. Moreover, the presence of high number of chromosomes in conjunction with their regular behaviour at meiosis and profuse fruiting in the tetraploid race lends further support to this view.

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#### EFFECT OF MOLYBDENUM NUTRITION ON MULTIPLICATION AND CONCENTRATION OF SUNN- HEMP MOSAIC VIRUS

HELMS AND POUND,<sup>2</sup> Welkie and Pound,<sup>8</sup> Pound and Welkie<sup>4</sup> and Shepherd and Pound<sup>6</sup> have reported the effect of zinc, manganese, iron and boron nutrition on multiplication of tobacco mosaic virus. A positive correlation between ammonium molybdate nutrition and susceptibility of certain crop plants to different virus diseases has been demonstrated by Kozłowska.<sup>3</sup>

However, in literature there was no report on the effect of molybdenum nutrition on the multiplication of any plant virus. Hence studies were undertaken to determine the effect of molybdenum nutrition on multiplication and concentration of an isolate of sunn hemp mosaic virus collected from Delhi and resembling in its properties the sunn hemp mosaic virus (Raychaudhuri *et al.*<sup>5</sup>). For the purpose sunn hemp seedlings of the same age and size raised in acid-washed quartz sand were transferred to one litre Pyrex glass beakers containing Hoagland's four salt solution [ $\text{Ca}(\text{NO}_3)_2$ ,  $\text{KNO}_3$ ,  $\text{MgSO}_4$  and  $\text{K}_2\text{HPO}_4$ ]. The micronutrient solution was the same as described by Arnon<sup>1</sup> with the exception of molybdenum. One ml. of 0.5% ferric tartrate was added for every litre of final solution. Different levels of molybdenum, *viz.*, 0.00, 0.005, 0.010, 0.015 and 0.030 p.p.m. in the form of molybdic acid were used. The solutions were prepared in demineralized water and the heavy metal contaminants were precipitated from the four main salts by co-precipitation method as described by Stout and Meagher.<sup>7</sup> Beakers were wrapped with gunny cloth and placed in shallow earthen pans containing water. Each beaker was fitted with a plastic lid having five holes at equidistance, holding two sunn hemp seedlings in each. The solutions in beakers were changed once in a fortnight and were aerated on alternate days. Groups of twenty-four plants were inoculated under each treatment when a definite growth response to different levels of molybdenum was evident. Similar number of plants kept uninoculated under each treatment served as controls. The height, fresh weight, and leaf area of the plants in each treatment (eight inoculated and eight non-inoculated) were recorded at the end of 5, 10 and 15 days following inoculations and the data of the experiments replicated thrice are represented in Fig. 1. The results indicate that there is a marked reduction in growth of the plants at 0.00 and 0.005 p.p.m. molybdenum levels. Plants exhibited pronounced chlorosis followed by vein clearing at the later stage. The growth increased gradually up to 0.010 p.p.m. and the maximum growth was recorded at this level (0.010 p.p.m.). Higher levels of molybdenum, *i.e.*, 0.015 and 0.030 p.p.m. resulted in progressively retarded growth of the plants, exhibiting yellow to orange colour discolouration of the leaves followed by irregularly distributed necrotic spots. However, for assaying the concentration of the virus the inoculated plants were cut at the base and were crushed into a fine pulp in a pestle and

mortar adding one ml. of phosphate buffer for every gram fresh weight of the plant material. The extract so obtained was centrifuged for 30 minutes at 3,000 r.p.m. and 2 ml. sample of clarified standard extract was then inoculated on leaves of guar [*Cyamopsis tetragonoloba* (L.) Taub.] plants by means of a ground glass spatula dipped only once in clarified standard extract and which was rubbed twice on the upper surface of the guar leaves, till the inoculum exhausted. Total number of lesions produced

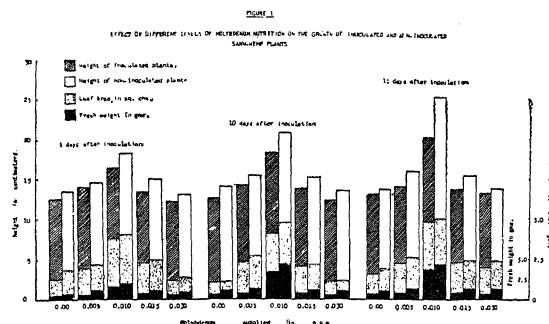
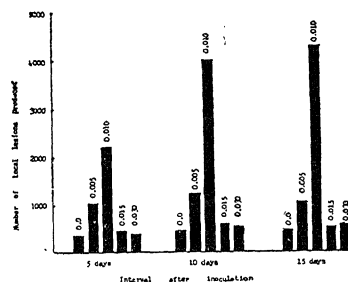


FIGURE 2  
EFFECT OF DIFFERENT LEVELS OF MOLYBDENUM NUTRITION ON MULTIPLICATION AND CONCENTRATION OF SUNN HEMP MOSAIC VIRUS



FIGS. 1-2

for each sample is presented in Fig. 2. The maximum concentration of the virus was obtained at 0.010 p.p.m. of molybdenum in each of the three assays, *i.e.*, after 5, 10 and 15 days intervals following inoculation. And it was lowest in assays conducted after 5 days but increased rapidly to maximum after 10 days. Assays conducted after 15 days intervals did not show any appreciable increase in the number of local lesions indicating thereby that the virus multiplied faster between 5th and 10th day after inoculation. Since the maximum growth of the plants also occurred at 0.010 p.p.m. of molybdenum the virus concentration is positively correlated with the plant growth.

I wish to express my deep sense of gratitude to Dr. R. S. Vasudeva for his keen interest in this work.

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# OCCURRENCE OF *GNOMONIA* *LEPTOSTYLA* (FR.) CES. AND DE NOT. ON WALNUT IN INDIA

It has been observed for the past five to six years that walnut trees in almost all the localities of the Kashmir valley are subject to a leaf blotch disease caused by a fungus the conidial stage of which is known as *Marssonina juglandis* (Lib.) Magn. and the perfect stage as *Gnomonia leptostyla* (Fr.) Ces. and De Not.

The disease appears conspicuously on the leaves in the month of July forming small circular light-brown spots 3-5 mm. in diameter. Later on these develop into large blotches, irregular in outline, sometimes involving a major portion of leaf lamina. Acervuli appear as small black spocks on the lower surface of the diseased leaves in early August. A section through the acervulus shows short, simple, hyaline, elliptic, one-celled conidiophores packed together in a small layer bearing a conidium each at their tips. The conidia are variously shaped being straight, ovoid, falcate or with only one end rounded and the other pointed. They are one septate, the two cells being unequal with prominent oil globules and measure  $15-26 \mu \times 2-5 \mu$ .

Towards the end of February, on dead, fallen and overwintered diseased leaves, brown coloured perithecia appear chiefly on the infected portions. The body of perithecium is immersed in the leaf lamina while the beak protrudes considerably outside the leaf surface. They are amphigenous, solitary, scattered globose, reddish brown with long cylindric neck which is 1-1½ times the diameter of perithecium. The beak measures 140-170  $\mu$  in length and 25-40  $\mu$  in breadth while the globose base has a diameter varying from 120-150  $\mu$ .

The ostiole at the apex of beak is round and measures 25-30  $\mu$ . The outer wall of the perithecium is dark brown and is composed of parenchymatic cells, while the inner layers are formed of irregular hyaline cells. The outer wall of the beak is composed of elongated, septate hyphae. The inner cavity of the perithecium is lined with club-shaped to fusoid asci in which 8 ascospores are arranged in two rows or rarely in one row in an oblique fashion. The neck is provided with short silky hairs-periphyses and has a broad ostiole at the tip. The asci are hyaline, paraphysate, 8-spored and measure  $56-62 \times 14-16 \mu$ . The ascospores are fusoid, straight or slightly curved, septate,  $15-19 \mu \times 4-5 \mu$  and hyaline.

The specimens have been deposited in Herbarium Cryptogrammæ indiæ Orientalis, New-Delhi.

The author is grateful to Mr. R. L. Munjal, Systematic Mycologist, Indian Agricultural Research Institute, New-Delhi, for help during the course of this investigation.

Mycology Section,  
Fruit Research Station,  
Lalmandi, Srinagar,  
Kashmir, September 8, 1961.

T. N. KAUL.

## TWO NEW FUNGI FROM HYDERABAD

DURING the routine collection, two interesting fungi were collected by the author of which one was growing as a saprophyte and the other as a parasite. On examination it was found that they were not reported earlier.

*Phaeosaccardinula marsilicæ* RAGHU. SP. NOV.

Infection spots round, dark brown, 1-3 mm. in diameter initially, coalescing into irregular patches later, ultimately infecting leaves completely, vegetative mycelium meagre, brown, branched, septate, 3-7  $\mu$  broad, perithecia produced in older parts, superficial, single, commonly produced near or on the veins, globular, 60-105  $\mu$  in diameter, glabrous, ostiolate, ostiole 19-30  $\mu$  across, perithecial wall consisting of pentagonal to polyhedral light-brown cells; ascic 6-12 in each fruit body, maturing in succession, club-shaped when young, ovate to oblong with truncate ends when mature, bitunicate, 36-60  $\mu$  long, 18-25  $\mu$  broad, octosporous; ascospores irregular or biserial, ellipsoidal to oval, muriform, 3-septate, dictyosporous, with 1 to 2 longitudinal walls, hyaline to subhyaline when young, brown when mature, 22-31  $\mu$  long, 9-15  $\mu$  broad.

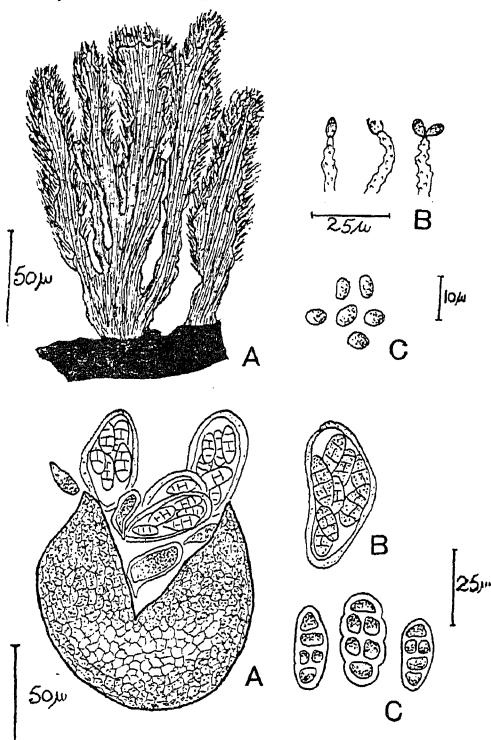
This fungus is identified as *Phaeosaccardinula* P. Henn as the characters of the fruit body, asci and ascospores are highly suggestive and

reported as a new species as it differs with species of *Phaeosaccardinula* P. Henn so far known.

Infecting leaves of *Marsilea quadrifolia* Linn., Hyderabad, 11th November 1961, Raghuveer, 'Herb. Hyd.' N.C.B.L. No. 5.

*Phaeosaccardinula marsiliæ* RAGHU. SPEC. NOV.

Infectionis maculae diametientes 1-3 mm., coalescentes in maculas irregulares latiores; mycelium exiguum, ramosum, septatum, brunneum, 3-7  $\mu$  latum; perithecia producta in partibus vetustioribus, singula, superficialia, glabra, globosa, 60-105  $\mu$  diam., ostiolata 19-30  $\mu$  diam., continentia ascos 6-12; asci bitunicati, juveniles quidem clavati, maturiores vero ovoides vel oblongi apicibus truncatis, 36-60  $\mu$  longi, 18-25  $\mu$  lati, maturescentes successive, octospori; ascosporae irregulares vel biseriatae, ex ellipsoideis ovoides, 3-septatae, dictyosporae, 1-2 parietibus longitudinalibus ornatae, juveniles quidem hyalinae vel subhyalinae, maturae vero brunneae, 22-31  $\mu$  longae, 9-15  $\mu$  latae.



FIGS. 1-2. Fig. 1. *Melanographium thunbergiae* from type specimen. A. Synnemata; B. Conidiophores with conidia; C. Conidia. Fig. 2. *Phaeosaccardinula marsiliæ* from type specimen. A. Fruit body with asci; B. Young ascus with ascospores; C. Mature ascospores.

Inficit folia *Marsilæ quadrifoliæ* Linn. ad Hyderabad, die 11 novembris, 1961, Raghuveer, et positus in 'Herb. Hyd.' N.C.B.L. sub humero 5.

*Melanographium thunbergiae* RAGHU. SP. NOV.

Synnemata arise from a common dark-brown stroma, long, cylindrical to clavate, branched or unbranched, consisting of septate unbranched; dark-brown hyphae, becoming free and loose in the fertile apical region, gradually turning light-brown, synnemata 210-994  $\mu$  long, 14-60  $\mu$  broad at the base, 42-112  $\mu$  broad apically, fertile apical ends of the hyphae (conidiophores) measure up to 30  $\mu$  in length and 2-5  $\mu$  in breadth, simple or geniculate with dentate margins due to successive production of conidia, conidia, acrogenous, continuous, ellipsoidal to oval, subhyaline when young, brown when old, 4-6  $\mu$  long and 2-4  $\mu$  broad.

This is a *Melanographium* Sacc. (= *Sporostachys* Sacc.) (see Saccardo, 1931, p. 936). Although *Melanographium* Sacc. (= *Sporostachys* Sacc.) is described to produce lenticular or reniform, continuous, fuliginous conidia, *M. anceps* Sacc. produces variable conidia somewhat nearer to the present fungus. But the fungus under consideration is distinct from *M. anceps* Sacc. in synnemal and conidial measurements. Hence it is reported as a new species. Growing saprophytically on the stems of *Thunbergia grandiflora* Roxb.; Hyderabad, 18th August 1960, Raghuveer, 'Herb. Hyd.' N.C.B.L. No. 6.

*Melanographium thunbergiae* RAGHU. SP. NOV.

Synnemate fasciculata e stromate basali emergentia, e longo-cylindricis clavata, ramosa vel integra, 210-994  $\mu$  longa, 14-60  $\mu$  lata ad basin, 42-112  $\mu$  lata at apices; synnemata constant e hyphis brunneis septatis simplicibus, apicibus evadentibus laxis et pallide brunneis in regione fertili producentibus conidia; conidiophori simplices vel geniculati, usque ad 30  $\mu$  longi, 2-5  $\mu$  lati, denticulati; conidia acrogena, continua, ex ellipsoideis ovalia, juvenilia quidem subhyalina, maturiora vero fusce brunnea, 4-6  $\mu$  longa, 2-4  $\mu$  lata.

I am deeply indebted to the Rev. Fr. Prof. H. Santapau for kindly providing Latin translations and to Sri. Khaja Nasrulla, Nizam College, for providing facilities. Thanks are also due to Dr. M. A. Salam, Osmania University, for suggestions and encouragement.

University Campus, P. RAGHUVEER RAO.  
Hyderabad-7, March 27, 1962.

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2. Saccardo, P. A., *Sylloge Fungorum*, Litho Painted by Edwards Brothers, Ann Arbor, Michigan, 1931, 25, 936.
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## REVIEWS

**Lie Algebras.**—*Interscience Tracts in Pure and Applied Mathematics Number 10.* By Nathan Jacobson. (Interscience Publishers, New York, London), 1962. Pp. ix + 331. Price \$ 10.50.

In this book the author presents a systematic account of the structure theory of Lie Algebras and their representations. It is meant to be a text-book for a course on Lie Algebras and is based on lectures which the author has given at the Yale University during the past ten years. Besides the usual general knowledge of algebraic concepts, a good acquaintance with linear algebra, elements of Galois theory and Wedderburn structure theory of associative algebras is presupposed. An idea of the coverage of the book may be obtained from the following listing of the chapter headings.

I. Basic concepts, II. Solvable and Nilpotent Lie Algebras, III. Cartan's criterion and its consequences, IV. Split Semi-simple Lie Algebras, V. Universal Enveloping Algebras, VI. The theorem of Ado-Iwasawa, VII. Classification of irreducible modules, VIII. Characters of the irreducible modules, IX. Automorphisms, X. Simple Lie Algebras over an arbitrary field.

A welcome feature of the book is the orientation prefixed to each chapter and a good number of exercises listed at the end of each chapter. These exercises (166 in all) are supplemented with occasional hints and references. An extensive bibliography and a general index add to the facilities of reference and further study. Although no attempt has been made to indicate the historical development of the subject, there are brief indications here and there of the names of those responsible for the main ideas. In short, it is a very valuable book on the subject.

M. S. HUZURBAZAR.

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**Spectroscopy (Vol. I)**—*Atomic, Microwave and Radio-frequency Spectroscopy.* By S. Walker, H. Straw. (Chapman & Hall, 37, Essex Street, London W.C. 2), 1961. Pp. xix + 287. Price 50 sh.

Although there are a number of well-known text-books on spectroscopy which deal with different branches of the subject separately at advanced level, there does not seem to exist that type of book at an introductory level from which the student can obtain a connected ac-

count of all the branches together, and thus gain an over-all picture of the fundamentals of spectroscopy and intelligently anticipate its applications to the many problems in chemistry and physics. The present publication, designed in two volumes, is expected to fill this gap and form an introduction to the more advanced books.

Volume I under review deals with four branches of spectroscopy, namely, Atomic, Microwave, Electron spin resonance, and Nuclear magnetic resonance. There is also a short chapter on Introduction to molecular spectra in which basic ideas about energies and energy levels are considered.

Atomic spectroscopy is dealt with in sufficient detail (it covers nearly half the volume) to give the necessary background for a full appreciation of the other three topics.

The book is well written and is reasonably up-to-date and can be recommended as a suitable text-book for the graduate and honours courses in Chemistry and Physics of Indian Universities.

The announcement on the cover says that Volume II in preparation will contain ultraviolet, Visible, Infra-red and Raman spectroscopy.

A. S. G.

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**Crossed-Field Microwave Devices.** By E. Okress, Editor-in-Chief. (Academic Press, Inc., New York), 1961. Vol. I: Pp. 648. Price \$ 22.00. Vol. II: Pp. 520. Price \$ 18.00.

The dynamical equations of motions of electrons in crossed electric and magnetic fields are so complicated that even now there are no self-consistent solutions for the trajectory of electrons in a magnetron, even though magnetron had its origin as far back as 1921 and proved to be indispensable in wartime radar. The book written by a number of authors presents successfully the fundamentals of all existing types of crossed-field devices. It enables the student, as well as the professional physicist and engineer, to perceive the problems posed by each element of the device in theory and in practice, to know the essential approach to solve these problems, and so, to approach the design of such devices in a scientific manner.

This is probably the second comprehensive book on crossed-field devices, the first one being

## THE LUMINESCENCE OF FLUORSPAR

SIR C. V. RAMAN

**C**ALCIUM FLUORIDE ( $\text{CaF}_2$ ) appears widely distributed in nature in the form of the mineral known as fluor spar or fluorite. In the year 1529, the usefulness of fluor spar as a flux in metallurgical processes was recognised, and after a lapse of four centuries this application of the material continues to be one of its most important uses, especially in the metallurgy of steel. Fluor spar is the only common mineral containing a large proportion of the element fluorine and it is therefore employed for the production of hydrofluoric acid by treatment with sulphuric acid, and therefrom also the production of the many organic and inorganic compounds of fluorine which find application in the arts and industries. Fluor spar is also used in the ceramic industries as an opacifier in the production of enamels and of glass. There are also other miscellaneous uses. It will be readily understood that in these circumstances, fluor spar is a much sought-after mineral. Indeed, at the present time, the world production of this material is over a million tons per annum.

Many countries possess workable deposits of fluor spar amongst which may be mentioned particularly the United States of America, the U.S.S.R., Great Britain, Germany, Spain and so forth. Until the present time, the deposits of fluor spar known in India were few and of small productivity. The recent discovery at Amba Dongar in the Baroda District of substantial deposits of fluor spar is therefore an event of more than ordinary interest and importance. The announcement which appeared in the Press greatly interested the author and led him immediately to contact the Geological Survey of India. Through the kindness of the officers of the Survey, he was enabled to obtain an ample supply of this fresh material. This served as an encouragement to the author to undertake a fact-finding investigation aimed at discovering the nature and origin of the luminescence exhibited by fluor spar, a phenomenon with which he had long been familiar and which had interested him for many years.

Fluorite, it should be mentioned, is a material of importance to the physicist for other reasons. It has a low refractive index and a low dispersive power in the visible region of

the spectrum,  $\mu$  being equal to 1.432 and 1.440 respectively at its red and violet ends. It has also a very low aqueous solubility. The melting point of  $\text{CaF}_2$  is  $1360^\circ \text{C.}$ , and synthetic optical crystals of as large a size as 150 millimetres in diameter and 125 millimetres in length have been successfully prepared by the well-known method of melting, casting and annealing in cylindrical platinum containers. The material thus fabricated is transparent throughout the spectral range from 0.125 microns to 9.0 microns. It finds uses as windows and prisms in ultra-violet, visible and infra-red spectroscopy, in telescope and microscope optical systems, apochromatic lenses and camera objectives.

Fluorite as found in nature displays some remarkable peculiarities of behaviour. It crystallises beautifully, the simple cube being the form most commonly found, though octahedra and other forms are also known. It also exhibits a perfect octahedral cleavage. Surprisingly enough, however, colourless crystals are rather rare; in the majority of cases, the mineral exhibits colours which both in respect of hue and saturation exhibit a great range of variation. By reason of the beautiful crystallisation and of the attractive colours displayed, fluorite specimens are spectacular exhibits in a museum. Some fifty such exhibits from different countries and from India are included in the author's collection. They are representative of the forms and colours exhibited by the mineral. Included in it are several single crystals which are transparent and colourless, as also single crystals in the form of octahedra and cubo-octahedra exhibiting nuances of colour; also clusters of cubes or octahedra attached to the matrix from which they crystallised out, aggregates of various kinds and also massive lumps. All colours ranging from yellow through green and blue to violet and purple are represented in the collection.

Another remarkable optical anomaly exhibited by the natural fluorite was long ago noticed and remarked upon by mineralogists. This is the fact that though it is a cubic crystal and hence should be optically isotropic, it very commonly exhibits a weak birefringence. This usually appears in the form of bands parallel to the cubic planes when a section is viewed between



the *Microwave Magnetron*, published in 1948 by the M.I.T. Radiation Laboratory. Many new developments such as the voltage-tuned magnetron, carcinotron, the magnetron amplifier, and strophotron have taken place in the post-war period. The theoretical and experimental aspects of these new developments are presented in these two volumes.

Much of the materials contained in this book was available in journals or obscure technical reports. It is not meant to be a text-book which has as its primary aim to lead the reader from topic to topic, developing each from fundamental principles. It is rather a compilation of papers from contributors mainly from the United States, Britain, Sweden, Japan and France, and presents various topics concerned with the post-war developments in crossed-field devices. Like most of the other group publications, one finds little coherence among different topics. The symbols used, though not uniform throughout all the papers, are listed at the end of each paper which makes it easy to read each paper out of context.

The book indicates what phenomena are not well understood, such as the steady-state behaviour and noise performance and this lack of understanding imposes limitations on gun design for linear injection systems. The book, in short, summarises the progress and the present state of our knowledge in the art of crossed-field microwave devices. In this respect, the book has achieved its purpose very successfully. This book, being the only single and compact source where one can find a record of valuable research work done during the last fifteen years, is highly recommended as an indispensable document to the individual worker and research laboratories dealing with microwave problems.

S. K. CHATTERJEE.

**Toxic Phosphorus Esters—Chemistry, Metabolism and Biological Effects.** By Richard D. O'Brien (Academic Press, New York; India: Asia Publishing House, Bombay-1), 1960. Pp. xii + 434. Price \$14.50.

The volume under review deals with the chemistry, metabolism and biological effects of organophosphorus compounds. These compounds which are phosphorus esters are generally toxic and serve as potent pesticides as also tools of research for study of diverse problems such as nerve function and the nature of active enzyme centres. A comprehensive account of the various biochemical and physio-

logical properties have been given and the various chapters have been so written as to emphasise the concept that the toxic effects of organophosphorus compounds are due to ester-ase inhibition.

After a brief historical introduction, Dr. O'Brien has dealt with non-enzymic reactions of toxic phosphorus esters, the reaction with cholinesterase *in vitro*, enzymic degradation and activation *in vitro*, and the effects of these compounds on isolated whole tissues, mammals, insects and plants, as well as the nature of selective toxicity exhibited by some of the organophosphorus compounds. In the last chapter, the author has given an account of the various techniques used in the analysis of these compounds. Also, details of electronic interpretation and chemical structure of a large number of organophosphates are given in the appendix. A pleasing feature is the emphasis on the practical applications of such toxic phosphorus compounds as diazinon, malathion and parathion, with an account of their metabolism and individual effects in animals, insects and in plants. In view of the growing problem of insect resistance to chlorinated hydrocarbons, particularly DDT, interest has increased of late in these insecticidal organophosphates which are as effective as the chlorinated compounds and which possess besides low mammalian toxicity. Scientists interested in agriculture, as well as physiologists and biochemists will find this volume fascinating to read and profitable to possess for the purpose of constant reference to various aspects of toxic phosphorus esters. The get-up of the book is excellent and leaves little to be desired.

P. S. SARMA.

**Annual Review of Biochemistry** (Vol. 30). (Annual Reviews, Inc., Grant Ave., Palo Alto, California), 1961, Pp. viii + 758. Price \$ 7.00.

The series of *Annual Reviews* on different branches of scientific research published by the Annual Reviews, Inc. California, are well known throughout the world, and these volumes are eagerly looked to every year by teachers and working scientists in the respective fields concerned. The earliest of these publications, *Annual Review of Biochemistry*, was started thirty years ago and is still going strong under the same able editorship of Prof. Murray Luck. Biochemists all over the world would wish to record their appreciation of this long service of Prof. Murray to the cause of biochemical literature and would wish him well for continued activity for many years more.

Volume 30 of the *Annual Review of Biochemistry* contains 24 review articles on topics already familiar to its readers, and covers their progress during the year 1960. The first article on "Biological oxidation", reviews new investigations on the relationship of structure to mechanism of action at molecular as well as cellular levels. A well-illustrated article on "X-ray studies of compounds of biological interest" by Rich and Green takes up the subject where it was left four years ago in the review in this series by Kendrew and Perutz, and deals with the results of X-ray investigations on amino-acids, peptides, and proteins; crystalline nucleic acid derivatives; and finally viruses. Progress on the "chemistry of the nucleotides" has been reviewed by Michelson, and that on "Nucleic acid metabolism and biosynthesis" by Abrams. There are articles on protein structure, protein nutrition, and specificity in protein synthesis. There are two articles on water-soluble vitamins, and one on fat-soluble vitamins. Recent work on the biosynthesis of steroid hormones and new pathways and enzymatic mechanisms involved in their transformations *in vivo* and *in vitro* are discussed by Engel and Langer. The last three articles in this volume are respectively on the biochemistry of Cultured mammalian cells, Genetic factors, and the Dividing cell.

Following the recommendations of the Enzyme Commission of the International Union of Biochemistry, the hitherto familiar coenzyme abbreviations DPN and TPN have been replaced by NAD (nicotinamide-adenine dinucleotide) and NADP (nicotinamide-adenine dinucleotide phosphate) in this volume.

The prefatory chapter is written by Prof. J. H. Northrop who discusses the present-day virus controversy and likens it to the enzyme controversy of fifty years ago. We quote the following from this chapter to bring out his thesis that history (of biochemistry) repeats itself:

"It is not surprising, therefore, that the history of biochemistry is a chronicle of a series of controversies in several of which I have been more or less engaged. These controversies exhibit a common pattern. There is a complicated hypothesis, which usually entails an element of mystery and several unnecessary assumptions. This is opposed by a more simple explanation, which contains no unnecessary assumptions. The complicated one is always the popular one at first, but the simpler one, as a rule, eventually is found to be correct. This process frequently requires 10 to 20 years. The

reason for this long-time lag was explained by Max Planck. He remarked that scientists never change their minds, but eventually they die." "At the present time, therefore, the virus controversy is in the same condition as was the enzyme controversy 50 years ago. There is a simple and unpopular hypothesis and a complicated and popular one, and another 30 years may be needed to reach a decision. What this will be cannot be predicted, but what can be predicted is that, when this controversy is ended, another similar one will take its place."

A. S. G.

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Fluctuations in Mitotic Index in the Shoot Apex of *Lonicera Nitida*. By Elizabeth Edgar. (University of Canterbury Publications, Christchurch, P.B. 1471, New Zealand), 1961. Pp. 91. Price 20 sh.

This is the first of a series of research monographs issued by the University of Canterbury, New Zealand. The present monograph describes the results of a carefully conducted study of the fluctuations in mitotic rate in the shoot apex of *Lonicera nitida* under various conditions. Although a considerable amount of information on the occurrence of diurnal periodicity of mitosis in shoot and root apices is available in the literature, this information has not so far been properly collated. Also, most of the available data stem from experiments carried out under artificial conditions of light and temperature. There is very little information on fluctuations of mitosis in plants growing in the field and hence the present work carried out under natural conditions presents some welcome additions to our knowledge.

While most investigators of periodicity in the shoot apex have been concerned only with an endogenous rhythm of cell division which persists when plants are grown in constant darkness and at a constant temperature, the cyclic change occurring within the apex itself with the formation of leaf primordia has never been critically studied. The primordia arise from the apex at more or less regular intervals of time—the interval of time between the formation of successive leaves being termed a *plastochron* and during each *plastochron* the apex goes through a cycle of characteristic shape changes. The author of this monograph is to be congratulated both for devising a method of investigating the fluctuations in mitotic index with the stage of *plastochron* and for studying the process intensively.

M. S. SWAMINATHAN.

**Discovery Reports.**—1. *The Appendages of the Halocypridae*. By E. J. Iles. Vol. XXXI. 299-326, 1961. Price 15 s. net. 2. *Salpa fusiformis Cuvier and Related Species*. By P. Foxton. Vol. XXXII. 1-32, 1961. Price 22 s. net. 3. *Reproduction, Growth and Age of Southern Fin Whales*. By R. M. Laws. Vol. XXXI. 327-483, 1961. Price 75 s. net. (Issued by the National Institute of Oceanography and Published by the University Press, Cambridge.)

The first account deals with an intensive study of *Conchœcia borealis* G. O. Sars var. *antipodæ* G. W. Miller (Halocyprididae, Ostracoda) and seeks to fill a lacuna in our knowledge of the anatomical and spatial relationships of the various limbs. The appendages are described in detail including a feature in the articulation of the mandible with the body. The method of capture of food, chiefly Copepoda, and the mastication of same are discussed. The appendages of *Archiconchœcia*, *Euconchœcia* and *Halocypris*, the other members of the family, are compared with those of *Conchœcia*; the mandibles of all these are found to have the same type of articulation but differences in the gnathobases of the mandibular coxæ exist. The differences noticed in the instance of *Halocypris globosa* and *H. brevirostris* are significant to warrant inclusion of these species in separate genera. The backward shift of the posterior limbs and of the position of the mouth present in Cypridinidae is absent in *Conchœcia*. The contribution is a valuable addition to our knowledge of the functional morphology, taxonomy and evolution of this group.

2. The salps are of great importance in the economy of the Southern Ocean especially as they occur in dense concentrations and being herbivores graze down the phytoplankters, thus competing with *Euphausia superba*, another herbivore, the favourite food of the whales. The account under review deals with *Salpa fusiformis* Cuv. and related species; the author has attempted to unravel the prevalent confusion among the four species and has established the four species, *S. fusiformis*, *S. aspera*, *S. thompsoni* and *S. gerlachei* on solid grounds and provided a key for identification. Relevant synonymy as well as morphological characters of taxonomic importance are discussed. The limits of the distribution of the species is touched upon but more details regarding their ecology is promised in a later account. The contribution will be of great help to students of marine ecology.

3. In the temperate countries, the whale fishery forms the backbone of several industries whose existence plays an important role in the economic life of the people. For any rational exploitation of the natural resources, an authentic knowledge of all aspects of the bios concerned is essential. The account by R. M. Laws (mentioned above) adds considerably to our knowledge of one of the whales, the southern fin whale, *Balœnoptera physalus* (L.), the only comprehensive account on the reproduction, growth and age determination of this species to-date. As the female is more concerned with the propagation of the species, the author devotes the bulk of the account to the gross and microscopic anatomy of the ovaries, and all aspects of the reproductive cycle. In addition, age determination by means of ovarian corpora is described, compared with the other methods and the validity of the ovarian corpora counts for age determination stressed. The account is well illustrated, results are compared with those of relevant earlier accounts. The twenty-five point summary and the exhaustive bibliography should prove very useful. Limitations of space forbid an ingression into the details of the achievement which is remarkable indeed considering the difficulties involved in an investigation of this nature and magnitude. The account should form a very valuable guide to all interested in the whale fishery in particular and fishery biologists in general and should help them to regulate the fishery in a rational manner.

All the three reports will form an asset to all biological research institutions.

R. SUBRAHMANYAN.

**A World Bibliography of Locusts.**—*Bibliographia Acrididiorum*. By M. L. Roonwal. A bibliography of the Orthopterous insects of the Family Acrididae (comprising the short-horned grasshoppers and locusts) from the earliest times to the end of 1954 (with some additions for 1955-57)—*Rec. Indian Mus.*, Delhi, 56 (1-4) [1958], 1961. Ppp. iix + 1-611-a, 1 ul.

*Bibliographia Acrididiorum* is a fairly bulky volume of over 600 pages, containing a world bibliography running to over 7,200 references on locusts and grasshoppers—Family Acrididae (Insecta—Order Orthoptera), covering a vast period from biblical times up to the end of 1954 A.D., along with some additions for the years 1955-57. It is a compilation for which Acridologists all the world over, as well as all ento-

mological workers in general, should feel grateful to the author, for the veritable mine of information he has provided.

The present publication takes one's memory back to the troublous years, 1929 and 1930, when India—in fact even a great part of Africa and Western Asia—suffered one of the worst locust infestations in the memory of man. Consequently, the Government of India started, with the ultimate object of combating this evil, a comprehensive scheme of investigations on the Desert Locust in India in 1931. The workers in the scheme, however, soon found to their dismay, a dearth of readily available references in respect of earlier work, so that a part of their time had to be diverted to a search for literature. A reference book of this type would have been invaluable to them, if it had then been available.

According to the author, it has taken him nearly 25 years to amass the stupendous amount of information from various sources and to have it analysed, arranged and typed, to make it press-ready. To him, the great self-imposed task must evidently have been a labour of love—being the outcome of his deep interest in the subject (in which he has 61 papers to his credit).

The publication consists of an introduction, the bibliography proper with an author index and a subject index, and two supplementary lists for the years 1955-57 accompanied by their appropriate indexes.

The Introduction gives a general idea of the latest trends in the classification of the various subgroups along with remarks on particulars of their distribution and habits. Interesting analyses of the various references in the bibliography as viewed from different aspects are also given. The earliest reference in historical times is that of the Arab writer, Ad-Damiri (d. 1430 A.D.) after which there is a blank for the 16th century. There are 13 references for the 17th century, followed by 43 for the 18th, 787 for the 19th, and nearly 6,000 for the 20th century up to the end of 1954.

The individual references in the bibliography have been arranged alphabetically author-wise, and chronologically under each author. In cases of multiple authorship, cross-references are given to the second and third author in alphabetical order. Wherever the name of the author is unknown, the items are shown under "Anonymous", or under the country concerned (e.g., Argentina, India, etc.), or under "International". All items except the cross-references are numbered serially.

The subject is conveniently divided under the various aspects of modern zoological research, such as General; Investigational reports; Morphology; Development; Physiology; Bionomics and Ecology; Phases and Biometry; Evolution and Genetics; Control; and Zoo-geography, Taxonomy and Faunistics.

Altogether the publication under review is a most useful book of reference for research workers on locusts and grasshoppers. It can be ordered directly from the Manager of Publications, Government of India, Civil Lines, New Delhi, or through any book-seller. In either case, the Code No. ZSI. 4. LVI. 1-4|800 should be quoted in addition to the title, author, journal, etc.  
Y. RAMCHANDRA RAO.

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**Treatise on Analytical Chemistry.**—*Analytical Chemistry of the Elements*. Edited by I. M. Kolthoff, Philip J. Elving. (Interscience Publishers, Inc., 250, Fifth Avenue, New York-1, N.Y.), 1961. Part II, Volume 5: Pp. xxi + 409. Price \$13.75; Part II, Volume 7: Pp. xxiii + 567. Price \$20.75.

The volumes in Part II of this comprehensive treatise present a systematic treatment of all aspects of classical and modern analytical chemistry. They form a source book of information and will be of great help to all practising analytical chemists.

Volume 5 deals with the analytical chemistry of the six elements Titanium, Zirconium and Hafnium, Thorium, Nitrogen and Phosphorus.

Volume 7 deals with Sulphur, Selenium and Tellurium, Fluorine, the Halogens, Manganese and Rhenium.

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**Atlas of Avian Hematology.**—*Agricultural Monograph 25, Atlas of United States Department of Agriculture*, By A. M. Lucas and C. Janroz. (Regional Poultry Res. Lab., East Lansing, Mich. Animal Husbandry Res. Divn.), 1961. Pp. vi + 271.

Avian hematology is a picture book that functions as a dictionary. The beautiful coloured illustrations presented in this volume vividly depict the nature and types of cells seen not only in the circulating blood of the adult bird but also that of the embryo and includes the developmental stages found in the blood forming organs of the fowl. The atypical, the unusual and the abnormal cells, one is likely to come across and representative studies on avian species other than the domestic chicken have also been described and illustrated.

The volume is the first in the programme designed to publish authoritative information on basic histology and anatomy of the fowl and more than justifies its claim as a reference volume in the study of "Avian hematology".

**Captured Stars.** By Heinz Letsch (Published by VEB Gustav Fischer Verlag Jena), 1959. Pp. 183. Price DM 16.

This is the English version of the 4th edition of the German book *Das Zeiss-Planetarium* by Heinz Letsch. This is a pictorial Handbook on the well-known Zeiss Planetarium. It contains a concise and popular account of the astronomical principles of the Planetarium, a description of the instruments used there and constructional details of the dome. The book is amply illustrated with 125 diagrams and persons concerned with the building or use of planetaria will find much useful information in this book.

A. S. G.

**Euglena—An Experimental Organism for Biochemical and Biophysical Studies.** By J. J. Wolken. (The Institute of Microbiology, Rutgers, The State University, New Brunswick, New Jersey), 1961. Ppp. xii + 173. Price \$4.50.

*Euglena* is a unicellular protozoan, more accurately an "algal flagellate". It has the characteristics of a plant but shares as well some of the attributes of an animal cell. It behaves as an animal cell in darkness, but as a plant in light. Hence it forms an ideal experimental organism to study such fundamental problems in biophysical and biochemical research as the effect of light on growth, the mechanism of energy conversion, transfer and storage of energy in living systems, photoreceptor organelles and their action, etc.

This is an amply illustrated informative book and gives the results of the author's studies extending over a period of ten years on *Euglena*. It shows how an apparently simple unicell can provide the research tools for many fundamental biological problems such as growth, cellular structure, pigment synthesis, the relation of chloroplast structure to photosynthesis, and photoexcitation to vision.

#### Books Received

From: Academic Press, New York and London:  
*Methods of Experimental Physics* (Vol. 3)—  
*Molecular Physics*. Edited by D. Williams,  
1962. Pp. xiv + 760. Price \$ 19.00.

*An Introduction to Elementary Particles.* By W. S. C. Williams, 1962. Pp. ix + 406. Price \$ 11.00.

*Advances in Mathematics* (Vol. 1, No. 1). Edited by H. Busemann, 1961. Pp. 102. Price \$ 3.80.

*Physical Techniques in Biological Research* (Vol. IV) *Special Methods*—Edited by W. L. Nastuk, 1962. Pp. xiv + 410. Price \$ 13.00.

*Methods in Hormone Research* (Vols. I and II). *Chemical Determination; Bioassay*. Edited by R. I. Dorfman, 1962. Pp. xii + 423. Price \$ 13.00; Pp. xv + 774. Price \$ 24.00.

*Air Pollution* (Vols. I & II). Edited by A. C. Sterin, 1962. Pp. xviii + 656. Price \$ 20.00; Pp. xvii + 586. Price \$ 18.50.

*Introductory Atomic Physics.* By M. Russell Wehr and J. A. Richards Jr., 1962. Pp. xi + 420. Price \$ 6.50.

*Cerebral Sphingolipidoses.* Edited by S. M. Aronson and B. W. Volk, 1962. Pp. xvii + 456. Price \$ 18.00.

*Introductory Organic Quantum Chemistry.* By Karagounis. Translated by F. C. Nachod, 1962. Pp. viii + 204. Price \$ 6.50.

*An Introduction to Probability and Mathematical Statistics.* By H. G. Tucker, 1962. Pp. xii + 228. Price \$ 5.75.

From: Cambridge University Press, 200 Euston Road, London N.W. 1:

*The Psychology of Insanity.* By Bernard Hart, 1962. Pp. xi + 127. Price 6 sh. 6 d.

*Viruses.* By K. M. Smith, 1962. Pp. 134. Price 21 sh.

*The Physics of Rain Clouds.* By N. H. Fletcher, 1962. Pp. x + 386. Price 65 sh.

From: Dover Publications, 180 Varick St., New York-14, N.Y.:

*Heredity and Your Life.* By A. M. Winchester, 1960. Pp. 333. Price \$ 1.45.

*The Orientation of Animals.* By G. S. Fraenkel and D. L. Gunn, 1961. Pp. 376. Price \$ 2.00.

*Conditioned Reflexes an Investigation of the Physiological Activity of the Cerebral Cortex.* By I. P. Pavlov. Translated by G. A. Anrep, 1961. Pp. xv + 430. Price \$ 2.25.

From: John Wiley and Sons, Inc., 440 Park Avenue South, New York-16:

*High Polymers* (Vol. XV)—*Radiation Chemistry of Polymeric Systems*. Edited by Adolphe Chapiro, 1962 Pp. xvi + 712. Price \$ 21.00.

*International Series of Monographs on Organic Chemistry.* By Ye L. Geffer. Translated from Russian by J. Burdon, 1962. Pp. vii + 302. Price 70 sh.

## SCIENCE NOTES AND NEWS

### Award of Research Degrees

The Cambridge University has recently awarded the degree of Sc.D. to Dr. M. L. Roonwal, Director, Zoological Survey of India, Calcutta, for his distinguished work in the field of Zoology, and particularly on the population dynamics and evolution of locusts, and on the biology and ecology of mammals and termites.

The University of Bombay has awarded the Ph.D. degree in Physics to Shri H. G. Devare of Tata Institute of Fundamental Research, for his thesis entitled "Beta-ray spectrometer and other studies of the decay-schemes of some radioactive nuclei".

The Osmania University has awarded the Ph.D. degree in Botany to Shri K. Venkatanarasimha Rao for his thesis entitled "Growth Conditions of *Oocystis Marssonii* Lemm and its Nitrogen Metabolism with special reference to Molybdenum".

Andhra University has awarded the Ph.D. degree in Chemistry to Shri V. Ramachandra Rao for his thesis entitled "Studies on Rare Earth— $\beta$  diketones".

### International Geological Congress

The Twenty-Second Session of the International Geological Congress will be held in India in 1964. The sessional Meetings will take place in New Delhi from the 14th to 22nd of December, 1964, with headquarters in the Vigyan Bhawan Building, Maulana Azad Road, New Delhi.

The membership fee for the Twenty-Second Session has been fixed at Rs. 100 for attending members and Rs. 75 for non-attending members.

The following subjects, each corresponding to a section of the Congress, have been selected for discussion: 1. Geology of petroleum; 2. Geological results of applied geophysics; 3. Cretaceous-Tertiary boundary including volcanic activity; 4. Rock deformation and tectonics; 5. Genetic problems of ores; 6. Minerals and genesis of pegmatites; 7. Plateau basalts; 8. Tertiary mammals; 9. Gondwanas; 10. Archaean and Pre-Cambrian geology; 11. Himalayan and Alpine orogeny; 12. Isostasy; 13. Charnockites; 14. Laterites; 15. Sedimentary geology and sedimentation; 16. Other subjects.

A typewritten or printed abstract (not more than 200 words) of each paper to be presented at the Congress must be received by the Secretary-General before June 1, 1963, and the full text of the paper limited to 5,000 words before December 1, 1963.

Some thirty excursions to places of geological interest in India are being arranged both before and after the Session.

All communications, until further notice, should be addressed to the Secretary-General, XXII International Geological Congress, Geological Survey of India, 27 Chowringhee Road, Calcutta-13.

### Symposium on "Fresh Water from the Sea"

The First European Symposium "Freshwater from the Sea" was held from May 31st to June 4th in Athens. This Symposium is the 39th Event of the European Federation of Chemical Engineering. Communications and discussions on the recent developments in obtaining freshwater from the sea were the aim of the Symposium. 385 persons from 26 countries participated in the Symposium.

In order to continue this work the European Federation of Chemical Engineering is examining the possibilities of constituting a working party on "Freshwater from the Sea" and of establishing a special Secretariat for this party in Athens.

The Conferences held at the Symposium "Freshwater from the Sea" will be published in the full wording and in the original language in Volume 47 of the *Dechema-Monographien* by the end of this year. For subscription of this volume kindly apply to the Dechema, Deutsche Gesellschaft für chemisches Apparatewesen, 6 Frankfurt (Main) 7, Postfach 7746.

### International Measurement Conference (IMEKO)

The First and the Second International Measurement Conferences were held in 1958 and in 1961 in Budapest. The Permanent International Preparatory Committee of the IMEKO Conferences finished its 4-day session on the 2nd March, 1962 in Budapest. Its task was to adopt scientific principles and take the first organizational steps toward the Third IMEKO Conference to be held in 1964.

Thirty scientists and specialists from 16 countries, 13 of them officially representing technical societies, took part in the Session. The International Preparatory Committee accepted the British, Japanese, and Italian Societies as new members, by which the number of Member-Organizations rose to 13.

The Committee accepted the invitation of the Swedish Member Organization (The Royal Swedish Accademy of Engineering Sciences) to arrange the next International Measurement Conference in Stockholm in April 1964. It was agreed that IMEKO 1964 be organized jointly with the traditional Swedish I and M. Conference. It was decided that the scientific programme includes approximately 120 lectures from all important fields of measurement.

#### Fourth Seminar on Electrochemistry

It is proposed to hold the Fourth Seminar on Electrochemistry at the Central Electrochemical Research Institute, Karaikudi-3, S. Rly., Madras State (India), sometime during the last week of December 1962, the exact date to be November 1962.

Intending participants are requested to send three copies of abstracts of papers (not exceeding 300 words) to the Convener of the Seminar, Dr. H. V. K. Udupa, Assistant Director, Central Electrochemical Research Institute, Karaikudi-3, S. Rly., not later than 15th September 1962, and two copies of the full papers by the 15th November 1962.

#### Symposium on 'Recent Developments in Iron and Steel-Making'

A Symposium on "Recent Developments in Iron and Steel-making with Special Reference to Indian Conditions" has been jointly arranged by the Indian Institute of Metals, the National Metallurgical Laboratory and the Iron and Steel Institute, England, from February 4 to 8, 1963. The Symposium will be held at the National Metallurgical Laboratory, Jamshedpur.

Further particulars can be had from Dr. T. Banerjee, Dy. Director, National Metallurgical Laboratory, Jamshedpur-7, India.

#### An Extensible Model of the Electron

The concept of an electron of finite size is an old one, first proposed by Abraham and Lorentz. It is the most natural concept that makes the total energy of the coulomb field of the electron finite.

Recently new evidence has appeared for the finite size of the electron by the discovery of

the muon having properties so similar to the electron that it may be considered to be merely an electron in an excited state. If one works with a point-charge model of the electron, there is no place in the theory for the muon. However, if one supposes the electron to have a finite size, with no constraints fixing the size and shape, one can arrange that the variations of size and shape are stable oscillations about an equilibrium position, and then one can assume that the lowest excited state is the muon.

In a paper (*Proc. Roy. Soc.*, 1962, 268A, 56) P. A. M. Dirac proposes that the electron should be considered classically as a charged conducting surface, with a surface tension to prevent it from flying apart under the repulsive forces of the charge. Such an electron has a state of stable equilibrium with spherical symmetry, if disturbed, its shape and size oscillate. The equations of motion are deduced from an action principle and a Hamilton formalism is obtained. The energy of the first excited state with spherical symmetry is worked out according to the Bohr-Sommerfeld method of quantization, and is found to be 53 times the rest-energy of the electron. It is suggested that this first excited state may be considered as a muon. The present theory has no electron spin, so it cannot agree accurately with experiment.

#### New Method for Detecting Cosmic Rays

A new approach for recording cosmic-ray showers is suggested by the Soviet physicist Gurger Askaryan, based on his finding that the electrons and positrons in these showers are absorbed at different rates by solid materials. This asymmetric absorption, he feels, will result in a net charge in the shower, the motion of which will produce radio signals detectable in the earth at depths great enough to shield out all competing radio-frequency noise. Askaryan suggests that recently-discovered underground strata in which radio-waves propagate would aid in detection of showers deep in the earth. —(*Nucleonics*, June, 1962.)

#### Shearing Interferometer to Test Aberrations of Microscope Objectives

Interferometric measurements of the aberrations of microscope objectives have been carried out so far mainly by means of a modified Twyman-Green interferometer. Such an arrangement has the advantage that it gives directly a picture of the wave front emerging from the microscope objective. Against this must be set the high cost of the apparatus, as

well as its complexity when it is desired to carry out off-axis tests as well as tests on the axis.

In a paper communicated to the *Optica Acta* (1962, Vol. 9, p. 159) P. Hariharan and D. Sen of the National Physical Laboratory of India, New Delhi, describe a new type of shearing interferometer devised by them, and its use for the measurement of aberrations. In this method, two images of the wave front under test which are of different size are made to interfere. When the centres of the two images coincide, this results effectively in shear along the radial direction. The interferogram obtained by this method bears a qualitative resemblance to the actual wave surface, and its exact quantitative interpretation is comparatively easy. The paper describes the application of this interferometer to the testing of microscope objectives. The results of on-axis and off-axis tests with some typical microscope objective are discussed.—(*Optica Acta*, 1962, 9, 159.)

#### Non-linear Interactions Point to Laser Advances

Availability of optical masers as an intense light source is spurring research into non-linear interactions at optical frequencies. At a meeting of the New England Section of the Optical Society of America, P. A. Miles of the Massachusetts Institute of Technology, reported on a neodymium glass optical maser with primary output of 1.06 microns and harmonic generation at 0.53 micron. At power level of only a few microwatts, little significance is seen for applications at this stage, but experimentation is expected to yield important information about non-linear processes in crystals. The theory of interaction between light waves in non-linear media predicts not only harmonic generators but mixers, modulators and demodulators, limiters and, in general, all the things which radio engineers have done at radio and microwave frequencies.

#### Satellite Communications

Intercontinental and worldwide satellite communications were discussed at a regional conference held recently in Seattle, U.S.A. Such systems are seen as operational within the next few years. Three families of satellite system will be needed: polar random, equatorial ring and synchronous systems. Synchronous system will employ 3 satellites, an equatorial ring 8 to 12, and a polar group 30 to 50.

Although there is not enough power available for high-quality TV broadcasts, it is expected

that worldwide TV will be possible in the 1970's. In the not distant future satellites will make important contributions in the following three areas of communications: (i) Long-haul, point-to-point links providing few circuits to remote areas of the world having light traffic loads. Transportable ground equipment would establish new circuits on short notice; (ii) Fixed, long-haul, point-to-point trunks providing many circuits between major traffic nodes, and (iii) Mobile communications between fixed points and mobile stations.

Most systems will employ satellites in high-altitude synchronous orbits, or in subsynchronous orbits.—(*Electronics*, June 8, 1962.)

#### Arsenic Content in Napoleon's Hair

A recent publication about the cause and mode of death of Napoleon has aroused scientific curiosity and some new techniques of modern physics are being used to throw light on the subject. Dr. Sten Forshufvud, *et al.* of the Department of Forensic Medicine, University of Glasgow, reported in *Nature* (1961, 192, 103), that the illness Napoleon suffered during most of his captivity on St. Helena was actually the syndrome of chronic arsenic intoxication with inter-current attacks of acute arsenic poisoning. Among the facts adduced in support of this theory was the finding that a few short hairs, known to have been taken from Napoleon's head, presumably the day after his death on May 5, 1821, showed a total arsenic content of 10.38 p.p.m., a value approximately thirteen times higher than the normal mean arsenic content of about 0.8 p.p.m.

Interesting results of further investigations on the distribution of arsenic in Napoleon's hair have been reported by the same authors in a recent issue of *Nature* (1962, 194, 725). This time the experiments have been conducted on a 13-cm. long hair placed at the disposal of the Forensic Medicine Laboratory by M. Clifford Frey, a textile manufacturer of Munchwilen, Switzerland, from a family heirloom, an authentic souvenir of Napoleon.

The hair was irradiated for 24 hr. by a flux of  $10^{12}$  thermal neutrons/cm.<sup>2</sup>/sec. in a nuclear reactor at the Atomic Energy Research Establishment, Harwell. On return from the pile the hair was fixed by means of self-adhesive tape to a piece of graph paper and then cut into 5-mm. lengths suitable for counting by an end-window Geiger counter.

The average daily growth of hair on the scalp is about 0.35 mm. On this basis a 13-cm.



hair should register a record of the exposures to appreciable amounts of arsenic for a period of a little less than a year.

From the results it is evident that for a period of about 4 months Napoleon was exposed to abnormally large amounts of a substance which was transformed into a radioactive isotope by the irradiation. This isotope has been confirmed to be arsenic. These distribution studies show that Napoleon was exposed to arsenic intermittently. The periodicity of the exposures agrees remarkably well with what can be deduced about the course of Napoleon's disease from the accounts of the eyewitnesses. No estimate, however, of the size of the arsenic dosage given to Napoleon can be made on the basis of these results.—(*Nature*, 1962, 194, 725.)

### Two Russian Spaceships in Orbit—Vostok III and Vostok IV

A great achievement in satellite launching and recovery was accomplished by Russia when she put into very nearly the same orbit two manned spaceships, Vostok III and Vostok IV, within 24 hours of each other, and, after four and three days of successful orbiting round the earth, effected their safe landing at a predetermined spot within six minutes of each other.

Vostok III was put into orbit at 11.30 a.m. Moscow Time, on August 11, 1962. It was piloted by cosmonaut Major Andrian Grigoryevich Nikolayev. Its period of revolution was 88.3 minutes, the perigee 183 kilometers, and the apogee 251 kilometers. The inclination of the orbit to the plane of the equator was  $64^{\circ} 59'$ .

Vostok IV, piloted by Lt.-Col. Pavel Popovich, was set in orbit at 11.02 a.m. Moscow Time, on August 12, 1962, when Vostok III was in its 16th revolution round the earth. The initial period of revolution of Vostok IV was 88.5 minutes. Its perigee was 180 kilometers and apogee 254 kilometers. The orbital plane was inclined at  $65^{\circ}$  to the equator.

The twin cosmonauts landed precisely in the planned area within 6 minutes of each other on August 15, 1962. Nikolayev landed at 09.55 hrs. (06.55 G.M.T.), and Popovich landed at 10.01 hrs. (07.01 G.M.T.).

Vostok III orbited the earth more than 64 times in 95 hours covering more than

2,600,000 km. (1,615,520 miles), while Vostok IV made more than 48 orbits in 71 hours covering about two million kilometers.

The task of setting two spaceships on the orbits close to each other was to obtain experimental data on the possibility of establishing contacts between two ships, co-ordinating the actions of the pilot cosmonauts, and to check the influence of identical conditions of space flight on human organism.

Major Nikolayev reported that while controlling his ship he watched through the porthole the flight of Vostok IV.

During flight both cosmonauts released themselves several times from the suspension system, got off their seats and "performed the operations and experiments prescribed by the programme".

The images of the cosmonauts transmitted by television cameras installed in Vostok III and Vostok IV were repeatedly relayed by central television and intervision. The cosmonauts transmitted on frequencies 20.006 and 143.625 Mc. A transmitter signal operating on the frequency 19.995 Mc. was also installed in the spaceships.

### Tables of Spectral-Line Intensities

*The National Bureau of Standards Monograph No. 32*, by W. F. Meggers, C. H. Corliss and B. F. Scribner, published in two parts, constitutes the most extensive set of tables of spectral-line intensities available in book form.

Part I gives the intensity, character, wavelength, spectrum and energy level of 39,000 lines between 2,000 and 9,000 Angstroms. The intensities were observed in a series of copper arcs, each containing 0.1 atomic percent of one of 70 elements. The data are presented in separate tables for each of the 70 elements. Part II presents the 39,000 observed lines in the order of their wavelengths.

Although the NBS "Tables of Spectral-line Intensities" are limited to 39,000 lines of 70 chemical elements, all intensities are calibrated, many wavelengths are improved, and energy levels for about 25,000 lines are included.

Part I is priced at \$ 4.00, and Part II at \$ 3.00. The monograph can be had from the U.S. Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C.

crossed nicols. A lamellar structure parallel to the faces of the cube is thus indicated for the material.

Still another property of fluorite as exhibited by some richly tinted specimens is the appearance of colours as seen by reflection at the surface of the crystal which are different from those seen by transmission through it. It is this phenomenon which led to the name "fluorescence" being given to effects of the same nature exhibited by other materials as well.

The present communication is a first report on the facts which have emerged from a study of the material at the author's disposal. With such an extensive collection of material, even the simplest observations when made on a com-

at the extreme red end of the spectrum. The luminosity of the specimen under ultra-violet excitation can then be readily observed. The red light escaping through the black-glass envelope of the lamp makes itself evident to the observer by reason of the reflection or diffusion of the light by the specimen. But this is readily recognised by its colour, and its disturbing effect may be greatly reduced by giving the surfaces of the specimen a smooth polish. By using specimens in the form of polished plates, the effect may even be completely eliminated. With a set of three lamps held together and backed by aluminium reflectors, the intensity of the ultra-violet excitation is notably enhanced. It is then possible to detect even the weakest luminescence.

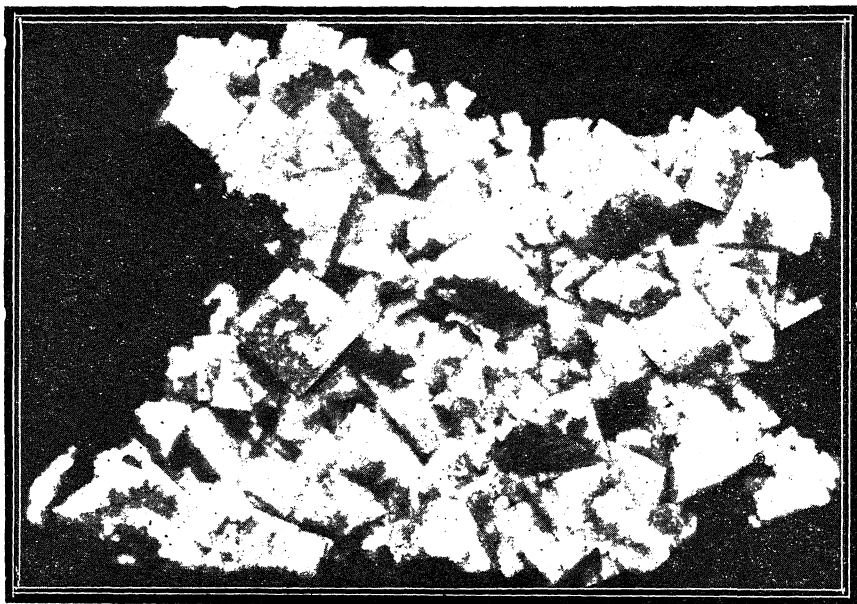


FIG. 1. Luminescence of Fluorspar.

parative basis serve to reveal the broad features of the case and to indicate the lines on which a more detailed and comprehensive investigation should proceed. We may, therefore, begin with the simplest of all the methods of study, *viz.*, the visual observation of the luminescence as exhibited by the various specimens. For this purpose, the most convenient way of examining the specimens is to view them in a darkened room under ultra-violet illumination. This is provided by a mercury arc of small size completely enclosed in a bulb of black glass which transmits the near ultra-violet radiation of the arc freely but cuts out all visible light except

The spectacular character of the effects exhibited by fluorspar under ultra-violet irradiation is illustrated in Fig. 1 which is a photograph of one of the specimens in the author's collection as thus seen. The largest dimension of the piece is some 20 centimetres. It is a close aggregate of cubic crystals of various sizes adhering to the matrix from which they were formed. The surface of the crystals is mostly covered by a thin deposit of quartz, and the specimen has therefore a very unattractive appearance in ordinary circumstances. But under the ultra-violet lamp, the superficial deposits are invisible and the entire specimen

glows with a resplendent blue. This is the characteristic colour of the luminescence of fluorspar which is much the same for all the specimens which exhibit the phenomenon, though the intensity of the glow varies enormously from specimen to specimen, and in a few cases the glow appears of a darker hue.

A remarkable feature exhibited by the crystal aggregates from Amba Dongar is that the luminescence is manifested in strata running roughly parallel to the external faces of the aggregate, a luminescent layer being located between layers on either side which are non-luminescent. The luminescent layer can be distinguished even in daylight from the non-luminescent layers on either side by its appearance and transparency, the luminescent layer being more transparent and colour-free than the non-luminescent ones.

That fluorspar can crystallise in two distinct forms which are respectively luminescent and non-luminescent is demonstrated in a very striking fashion by the single crystals from Amba Dongar of which many are in the author's possession. The surprising fact emerges that part of the volume of the same crystal may be luminescent and the other part may be non-

plates and their two faces then polished. It is then found that part of the area of the plate may be luminescent and the other part non-luminescent, the boundaries between them being sharply defined. A great number of section-plates of this kind showing these features have been prepared in the course of the investigation.

The most perfect specimens of fluorite in the author's collection exhibit the usual blue luminescence. This is weak, but readily observable. On the other hand, there are numerous single crystals, both large and small, in the collection in which the effect is unobservable and which therefore must be designated as belonging to the non-luminescent class of fluorite. The question arises whether the artificially prepared fluorite of optical quality would or would not exhibit luminescence. This question can only be answered by actual study of such material. Three specimens were available for examination, which were obtained respectively from Great Britain, U.S.A. and Germany. The British and American specimens were found to be blue-luminescent, though only weakly so and to an extent comparable with natural fluorite of the best quality. On the other hand, the product from Germany showed not a trace of the phenomenon.

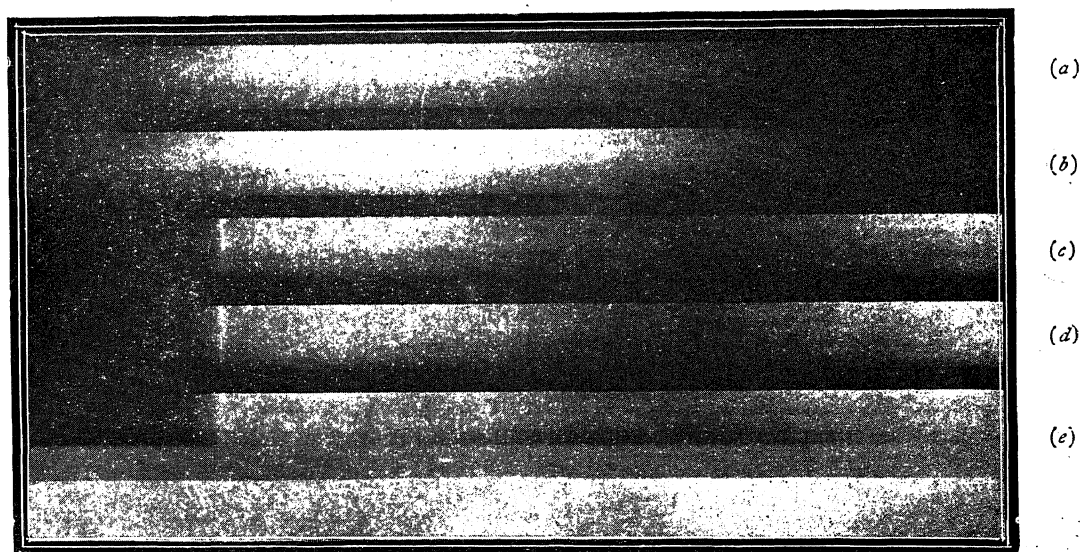


FIG. 2. Luminescence Spectra of Fluorite. (a), (b) Room Temperature; (c), (d), (e) Liquid Air Temperature.

luminescent, the boundary between the two parts being a sharply defined plane. Irregular lumps which do not exhibit well-defined crystal faces may be ground down into the form of

The most important questions regarding the luminescence of fluorite which need to be answered are firstly, why does it appear in the region of the spectrum where it is observed,

and secondly, why it does vary so enormously in its intensity from specimen to specimen? Highly instructive in regard to both of these issues is the result of a spectroscopic study of the luminescence. Visually observed, the spectrum appears as a continuous band extending from the violet into the blue and perhaps a little beyond. This is confirmed by a photographic record of the spectrum. A remarkable change in the character of the emission however appears when the specimen is held continuously at the temperature of liquid air during the exposure. This change is exhibited by the spectrographs reproduced as Fig. 2. The two spectra (a), (b) appearing at the top

The emission at 4125 Å has been recorded with several different specimens and it is clearly a characteristic feature of the luminescence of fluorspar. That it appears only when the crystal is cooled down to low temperature is a readily understood feature. Such a sharpening of the emission spectra at low temperatures is known in other cases, as for example, the luminescence of the uranyl salts. We are, therefore, justified in inferring that the luminescence of fluorspar is an inherent property of the crystals which show the phenomenon and that it indicates the presence of specific electronic levels between which a transition can occur in their cases.

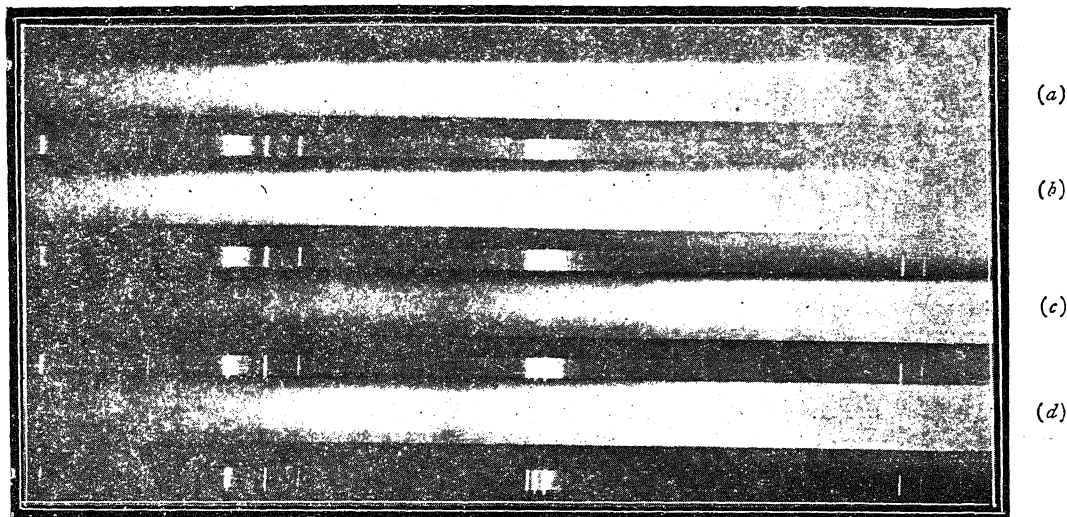


FIG 3. Absorption Spectra of Green Fluorite. (a), (b) Room Temperature; (c), (d) Liquid Air Temperature.

of the picture were recorded with different exposures with the specimen held at room temperature, while the three spectra below (c), (d) and (e) were likewise recorded but with the specimen cooled down to liquid air temperature. The heavily-exposed spectrum at the foot of the record is that of the mercury arc after removal of the black glass filter held in front of it for exciting and photographing the luminescence spectrum. It will be noticed that the lowering of the temperature of the luminescent fluorite has resulted in the continuum extending to the violet end of the spectrum being replaced by a sharply defined emission located at 4125 Å, followed by a set of imperfectly resolved bands extending into the blue; further, an emission appears in the region of longer wavelengths which is not recorded when the specimen is at room temperature.

Comparative study of the luminescence of numerous specimens of fluorite shows very clearly that the intensity of luminescence is correlated with the appearance of visible colour in the specimens. In particular, it is noticed that fluorite exhibiting lighter shades of green emits a luminescence of extraordinary intensity, but that on the other hand, the strength of the luminescence is less when the colour of the fluorite is of a deeper green. These facts indicate that visible colour in fluorite arises from the possibility of inner electronic transitions, which if they occur in one direction result in luminescence and if in the opposite direction result in absorption and the manifestation of visible colour by the specimen.

Accepting the foregoing view of the origin of the colours observed in natural fluorite, we

should expect to find that their absorption spectra should, as in the case of the emission spectra, resolve themselves into well-defined bands when the material is cooled down to liquid air temperatures. That this is actually the case is shown by the spectra reproduced in Fig. 3. They were obtained with a piece of fluorspar exhibiting a bright green colour and which also showed a strong luminescence. The two spectra at the top of the picture record the light of a tungsten filament lamp after transmission through the piece of fluorspar when the latter is held at room temperature. The two lower spectra represent the effect of cooling down the specimen to the temperature of liquid air on the transmission. The appearance of specific absorption bands is very clearly seen in the latter two spectra. The mercury arc spectrum has been recorded in the plate to indicate the positions where the bands appear.

The appearance of weak birefringence patterns in natural fluorite is a feature of great interest calling for an explanation. The present investigation has revealed that this is a field of investigation which is not unrelated to the explanations of the luminescence and of the colours exhibited by natural fluorite. Amongst the facts which indicate such a connection is that a marked difference is noticeable between the appearance of the luminescent and non-luminescent areas in a section-plate of fluorite when it is viewed between crossed polaroids. In several cases, also, it has been noticed that the luminescence resolves itself into a set of parallel laminae in positions adjacent to or coincident with the lamellae visible in birefringence. The further unravelling of these relationships can, however, well await the results of a more detailed and elaborate investigation of the whole subject.

#### MULTIPLE-BEAM KLYSTRON

THE GEC has developed a multiple-beam klystron (MBK) by means of which up to 100 times more microwave superpower energy than is now possible can be generated. A factory-built 10-beam MBK has produced a sustained level of 32 kw. CW *r-f* output at X-band using routine test methods. Operating at 32% efficiency, the MBK was completely stable, had a 46 db gain at 12 kv. input and a beam transmission in excess of 99%.

In a typical 10-beam MBK, a low-level *r-f* signal is fed in to the tube's input cavity, which is in effect a periodic waveguide circuit, physi-

cally extended in one direction. In the MBK waveguide circuit, the signal interacts with each of the 10 beams and the entire system is "phase-locked". The sum of the power contributions from each of the individual beams is combined in an extended output cavity and directed to one or more waveguide output windows.

A unique feature of MBK's is the very low harmonic power output. The electrical relationship between the tube's multiple beams is such that an inherent harmonic cancellation can be produced.—(*J. Frank. Inst.*, 1962, 273, 537.)

#### DR. SYED HUSAIN ZAHEER

WE are glad to note the appointment of Dr. Syed Husain Zaheer as Director-General of the Council of Scientific and Industrial Research. He succeeds Professor M. S. Thacker and took charge of his office on 1 September 1962.

Born on 7 November 1901, Dr. Zaheer had his education at Lucknow, Oxford and Heidelberg. Throughout his career Dr. Zaheer has been closely associated with teaching and research. He served the Lucknow University from 1930 to 1948, first as Reader and then as Professor of Organic Chemistry.

In 1948 he was appointed as the Director of the Central Laboratories for Scientific and Indus-

trial Research, Hyderabad. These laboratories were taken over by the Council of Scientific and Industrial Research in 1956 and constituted as the Regional Research Laboratory, Hyderabad. During the fourteen years of his directorship, he built up the Regional Research Laboratory as an important centre for pilot plant and developmental research in the country.

Dr. Zaheer is the author of several research papers in organic chemistry, coal chemistry and technology, oils and fats, surface coatings, heavy chemicals and fertilizers.

He has been keenly interested in many important industrial development projects in the country.

## THE GENERALIZED DESCRIBING FUNCTION AND ITS APPLICATIONS

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THE technique of the describing function as a tool of design has been emphasized and demonstrated by several authors.<sup>1-3</sup> Johnson<sup>4</sup> has discussed at length the necessary assumptions and the accuracy attainable by this method. Klotter<sup>5</sup> has extended this concept to include the case of dynamic non-linearities. West<sup>6</sup> and his colleagues have developed the idea of dual input describing functions. A transformation method capable of dealing with all the above categories has been developed by the author.<sup>7-9</sup>

However, the describing function is valid only in the steady state. Therefore it is used as a design technique to ascertain desirable performance characteristics in the steady state only. It is incapable of giving any information on the transient performance, as it cannot discriminate between different sets of initial conditions. It is well known that initial conditions play a vital role in non-linear systems.

The object of this paper is to extend the concept of the describing function for purposes of analysis and synthesis even in the transient state. This extended concept may be termed the generalized describing function or the g.d.f.

With this view, a damped sinusoid like  $ae^{-pt} \sin wt$ , ( $p > 0$ ), has been considered as the input to the non-linear component. The important feature of this concept is that the conventional describing function can be obtained as a special case of the generalized describing function as  $p$  tends to zero. It is also interesting to notice that the g.d.f. is in the time domain, and the corresponding Laplace Transform has to be used for design in the  $s$ -plane. Thus it is the presence of  $s$  in the Transformed g.d.f. that extends the scope of this function to the transient state also.

As the non-linear component can now be represented by an  $s$ -function, the effect of the initial conditions can be accounted for, and the analysis of the non-linear control system can now be carried out on the basis of the root loci with its inherent advantages. The following procedure clarifies the sequence of operations necessary in arriving at the g.d.f. in the  $s$ -domain.

It has been shown in reference 7 that the characteristic of a static component can be re-

presented by an algebraic equation. Therefore with reference to Fig. 1, let

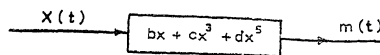


FIG. I. CHARACTERISTIC OF THE NON-LINEAR COMPONENT.

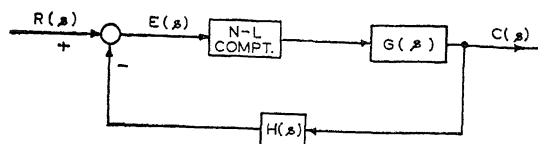
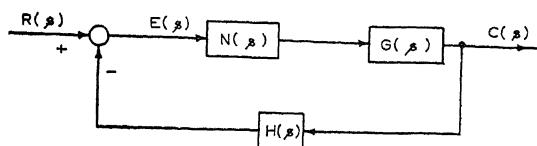


FIG. II. TYPICAL NON-LINEAR CONTROL SYSTEM.

FIG. III. THE NON-LINEAR COMPONENT OF FIG. II IS REPLACED BY ITS a.d.f. IN THE  $s$ -DOMAIN

FIGS. 1-3

$$f(x) = bx + cx^3 + dx^5, \quad -1 \leq x \leq +1, \quad (1)$$

be the characteristic of the component.

Let

$$x = ae^{-pt} \sin wt, \quad p > 0, \quad (2)$$

be the input to the non-linear component.

This expression for  $x$  is substituted into the non-linear characteristic, giving rise to the response of the component as follows.

$$\begin{aligned} m(t) = & bae^{-pt} \sin wt + ca^3e^{-3pt} \\ & \times \left[ \frac{3}{4} \sin wt - \frac{1}{4} \sin 3wt \right] \\ & + da^5e^{-5pt} \left[ \frac{10}{16} \sin wt - \frac{5}{16} \sin 3wt \right. \\ & \left. + \frac{1}{16} \sin 5wt \right]. \end{aligned} \quad (3)$$

The generalized describing function in the time domain may be defined as the ratio of terms containing  $\sin wt$  in the output, to the

exponentially time varying amplitude of the sinusoidal input to the non-linear component. This expression may be denoted by  $n(t)$ . From equations (1), (2) and (3),  $n(t)$  may be written as follows:

$$n(t) = b + \frac{3}{4} ca^2 e^{-2pt} + \frac{10}{16} da^4 e^{-4pt}. \quad (4)$$

The justification for the above procedure is exactly similar to that of the conventional describing function.

At this stage it may be observed that the g.d.f. is in the time domain, and for  $p$  tending to zero, the conventional describing function is obtained. Hence the justification in the choice of the name 'g.d.f.' to denote this concept. However, it must be emphasized that the conventional describing function, being a function of amplitude and frequency only, may directly be used for a study of the frequency response of the system containing the non-linear component. Since the g.d.f. derived as above is an explicit function of time, the Laplace Transform of the g.d.f. is necessary for the  $s$ -plane study of the system. Thus the Laplace transformed g.d.f. may be denoted by

$$N(s) = \mathcal{L}[n(t)]. \quad (5)$$

From equations (4) and (5)

$$N(s) = \frac{b}{s} + \frac{3}{4} \frac{ca^2}{s + 2p} + \frac{10}{16} \frac{da^4}{s + 4p}. \quad (6)$$

Even when  $n(t)$  has a phase shift with reference to the input  $x(t)$ ,  $N(s)$  may be expressed as the ratio of two polynomials in  $s$ .

It must also be emphasized that the effect of initial conditions comes into picture only after obtaining the expression for  $N(s)$ , and while working in the  $s$ -plane. This restriction is necessary to preserve the uniqueness of the g.d.f. in the time domain. The effect of such a restriction on dynamic non-linear components requires careful examination.

Figure 2 shows a typical closed loop non-linear control system. Having derived the expression for  $N(s)$  as per equation (6) Fig. 2 may be re-drawn as in Fig. 3, which is in the required form for study in the  $s$ -plane.

From equation (6), it may be noticed that in general  $N(s)$  is a ratio of two polynomials in  $s$ , and depends on  $a$ ,  $p$  and possibly  $w$ . Therefore the forward transfer function may now be written as the product  $N(s) G(s)$ ; and the general equation for the root locus<sup>10</sup> may be written as

$$|GH| = 180^\circ - |N|. \quad (7)$$

Figure 3, along with equations (6) and (7), brings out the important role of the g.d.f. in the root locus study of closed loop non-linear control systems.

As transient performance is of interest only when steady state stability has been ascertained, the conventional describing function may first be used for the frequency response analysis. This analysis gives an indication of the range of interest for  $a$  and  $w$ . At this stage, to reduce the number of the arbitrary parameters,  $a$ ,  $p$  and  $w$ , it may be logical to fix up the value of  $p$  as a positive number  $p_0$ , comparable to the inverse of the largest time constant of the system. Now equation (7) may be written as

$$|G(s)H(s)| = 180^\circ - |N(p_0, a, w, s)|. \quad (8)$$

Equation (8) indicates that a modification is necessary in drawing the root loci based on the g.d.f. This may be briefly stated as follows:

The conventional root loci are plots of the variations of the closed loop poles with changes in open loop gain. Thus the open loop gain is used as a parameter to be adjusted suitably to yield relative stability.

While applying the principles of root loci, in the context of equation (8) it is best to specify the open loop gain at a particular value, and obtain the loci with  $a$ , the scalar amplitude of the sinusoidal input to the non-linear component, as the parameter. The significant values of  $w$  can be obtained from the conventional frequency response analysis. These values of  $w$  give rise to a family of root loci, on each member of which  $a$  is treated as a parameter. This is possible since  $p$  has already been fixed. Therefore the relative stability of the system may now be analysed in terms of  $a$  as parameter, and compensation by means of scalar gain factor is also possible.

Further details of constructing the root loci, possible alternative techniques of transient analysis along with computer solution of specific problems will be published elsewhere.

The author gratefully acknowledges the interest and encouragement of Prof. H. N. Ramachandra Rao, and the facilities provided by the authorities of the Indian Institute of Science in the preparation of this paper.

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## ISOTOPE SHIFTS AND INTERNAL CONVERSION OF $\gamma$ -RAYS\*

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INVESTIGATION of isotope shifts in energy of atomic spectral lines provides a tool for studying nuclear charge distribution. Isotope shifts due to finite mass of the nucleus are important in light elements but become negligible for atoms of heavy elements. For elements in medium and heavy mass region,  $A > 80$ , isotope shifts due to non-zero volume of the nucleus, called volume effect, become important. It is the study of this volume effect in isotope shifts which can be used for investigating properties like nuclear charge distribution, deformation of nuclear shape and compressibility of nuclear matter. In these areas, therefore, measurements on volume effect in isotope shifts will provide valuable information, supplementary to the results obtained from nuclear spectroscopic studies of nuclear energy levels. Detailed interpretation of volume effect in isotope shifts in the mass region, where nuclear shape deformation is pronounced, will also involve consideration of specific nuclear models, which is of great interest to nuclear physicists.

For a nucleus treated as a point charge, the potential at a distance  $r$  is  $-Ze^2/r$ . For a finite nucleus with a certain charge distribution of radius  $r_0$ , the potential at  $r < r_0$  will be different from this value. The energy of an electron in an orbit which penetrates the nuclear volume, i.e.,  $s$ -states and to a slight degree  $p_{\frac{1}{2}}$ -state, will be different from that calculated for a point charge nucleus. The addition of neutrons to a given nucleus alters its radius and charge distribution and the effect of penetration on the position of energy level of the  $s$ -electron is different in different isotopes. This gives rise to volume effect in isotope shifts. On the basis of such considerations, the change

in energy  $\Delta E$ , of an  $s$ -state electron is obtained as follows:

$$\Delta E = \int P(r) \left[ V(r) + \frac{Ze^2}{r} \right] d\tau$$

where  $d\tau$  is volume element and  $P(r)$ , which is  $s$ -electron density in the neighbourhood of a point charge in Dirac theory is

$$P(r) = \frac{2(2\rho + 1)}{[I'(2\rho + 1)]^2} \cdot \psi^2(0) \left( \frac{2Zr}{a_H} \right)^{2\rho-2}$$

where  $\rho = (1 - Z^2 a^2)^{\frac{1}{2}}$ ,  $a$  being the fine-structure constant.

$a_H$  = first Bohr radius and  $\psi(0)$  is the non-relativistic Schrodinger wave-function at  $r = 0$ .

$$\therefore \Delta E = F(Z) \psi^2(0) \cdot R_1^{2\rho}$$

where

$$F(Z) = \frac{12\pi Ze^2(\rho + 1)}{[I'(2\rho + 1)]^2 \cdot \rho(2\rho + 1)(2\rho + 3)} \left( \frac{2Z}{a_H} \right)^{2\rho-2}$$

$$R_1 \equiv \left[ \left( 1 + \frac{2\rho}{3} \right) \langle r^{2\rho} \rangle \right]^{1/2\rho}$$

$$\langle r^{2\rho} \rangle = \int f(r) r^{2\rho} \cdot \frac{d\tau}{Z}$$

and  $f(r)$  is normalized so that  $\int f(r) d\tau = Z$ . The perturbation energy shift between two isotopes differing by  $\delta R_1$  in equivalent radius, i.e., the isotope shift due to volume effect is then given as follows:

$$\delta \Delta E = 2\rho F(Z) \psi^2(0) R_1^{2\rho} \frac{\delta R_1}{R_1}$$

If nuclei are spherical and the nuclear radius varies as  $A^{\frac{1}{3}}$ , one gets certain results about isotope shifts, which are, however, different from what is actually observed. For even isotopes of a given element, for instance, the addition of successive two neutrons should give equal shifts. Actually this is not the case. There are fluctuations in the value of the ratio of observed to theoretically predicted (on spherical model) shifts,  $\delta \Delta E_{obs.} / \delta \Delta E_{th.}$ , in isotopes

\* Based on a Review talk given at Nuclear Physics Symposium, Madras, in February 1962.



of a given element with neutron number and this variation is strongly reminiscent of the change in quadrupole moment with neutron number. These fluctuations have been explained in terms of nuclear deformation and shell structure. (Fig. 1).

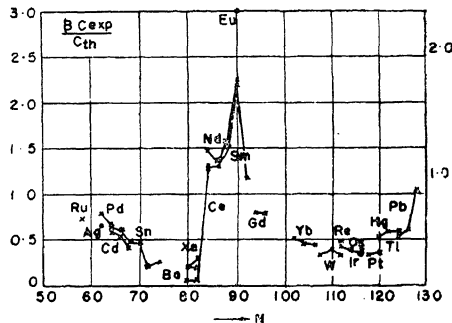


FIG. 1

Nuclei which are non-spherical will appear more extended radially than spherical nuclei of the same volume, after averaging over all angles. Considering a uniformly charged spheroidal nucleus, an expression relating the isotope shift to the change in square of deformation parameter with neutron number,  $\delta\beta^2/dN$ , has been derived (Willets, Hilland Ford)

$$\frac{\delta\beta^2}{dN} = \frac{10}{3(2\rho + 3)A} \frac{(\delta\Delta E)_\beta}{(\delta\Delta E)_v}$$

If one plots the ratio of observed shift to predicted volume effect on spherical model against neutron number, there should be a large value where the rate of change of deformation is large. When one uses values for deformation parameter obtained from nuclear spectroscopic data on Coulomb excitation and E2 transition probabilities and the data on isotope shifts, the above relation is seen to hold good fairly well. The data on isotope shifts, however, are not as plentiful as one would like. The case of the six even isotopes of Gadolinium  $A = 152$  to  $160$  is instructive in this regard. Going from  $A = 152$  to  $154$ , there is a large change from near spherical to deformed shape, and this is reflected in a large value for the ratio  $q = (\delta\Delta E)_\beta / (\delta\Delta E)_v$ . In the heavier isotopes of mass number  $156, 158, 160$ , though the deformation itself is large, the rate of change of deformation with addition of two successive neutrons is small. This may be seen from Table I which gives the values of the ratio  $q$ , deformation parameter  $\beta$  and  $\delta\beta^2/dN$  for these isotopes.

A similar trend is observed for Samarium isotopes  $A = 148$  to  $152$ , though the data are not adequate. Recently Kuhn and Turner have reported their results on isotope shifts in even

TABLE I  
Gadolinium isotopes,  $Z = 64$ 

A	152	154	156	158	160
N	88	90	92	94	96
$\beta$	0.57	0.3	0.41	0.46	0.47
$q$	1.6	0.9	0.05	0.01	
$\delta\beta^2$	0.09	0.08	0.04	0.01	

isotopes of Tellurium  $A = 120$  to  $130$ . Using interferometric method they determined the relative shifts in fringe systems of the  $4049 \text{ \AA}$  line due to a mixture of isotopically enriched samples. Their values corrected for normal mass-shift are reproduced in Table II.

TABLE II  
Tellurium isotopes,  $Z = 52$ 

A	120	122	124	126	128	130
N	68	70	72	74	76	78
$\delta\Delta E$ $10^{-3} \text{ cm}^{-1}$	20.9	19.7	15.6	15.0	12.9	

The general decrease in the value of the shift from neutron number 68 to 78 follows the same trend as the variation in deformation parameter,  $\beta^2$ , for these isotopes obtained from the results on Coulomb excitation measurements of Stelson and McGowan.  $\delta\beta^2/dN$  is found to decrease regularly in this range of neutron numbers. In Fig. 2 are plotted the isotope shifts against neutron number for even isotopes of Tin,  $Z = 50$  and Tellurium  $Z = 52$ . It is seen that the shift decreases more steeply for Tin than for Tellurium, which is presumably due to the effect of the completed magic shell of 50 protons in Tin.

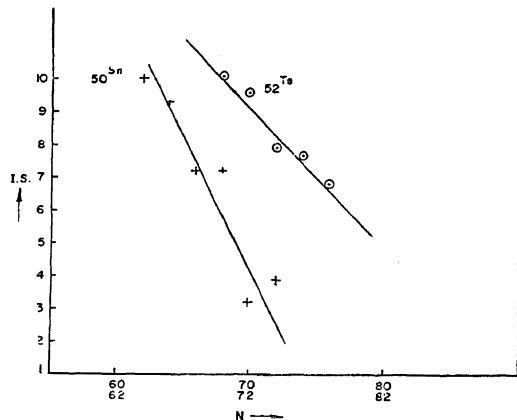


FIG. 2

The trends in variation of volume effect in isotope shifts are thus reasonably well explained in terms of the nuclear deformation. To interpret the actual values of isotope shifts, however, the effects due to nuclear compressibility and

surface effects have to be taken into account. The shifts, on the average, are smaller than the predicted values.

If nuclear radius  $R = r_0 A^{\frac{1}{3}}$  where  $r_0$  is a constant,  $\delta R/R = 1/3 A$ . However,  $R$  is a function of  $N$  and  $Z$ . Taking Coulomb forces into account,

$$\frac{1}{R} \cdot \frac{dR}{dN} = \frac{1}{3A} \left[ 1 - \frac{4Ec}{E_0'' + Ec} \right]$$

where  $Ec = 3 Z^2 e^2 / 5 r_0 A^{\frac{1}{3}}$  and  $E_0'' = K.A$ ,  $K$  being compressibility. The isotope shift depending on  $dR/R$  will be reduced by a factor  $1 - 4Ec/E_0'' + Ec$ .

Another observation in isotope shift measurements which has not yet received proper explanation is that called "Even-odd staggering". It is found that the centroid of an *hfs* pattern due to an odd isotope lies closer to the line of its lighter even-even neighbouring isotope than to the line due to the heavier neighbour.

#### INTERNAL CONVERSION PROCESS

In making a transition from one level to another, the nucleus can give up energy  $K$ , angular momentum  $L$  and parity  $\pi$ , in the form of a  $\gamma$ -ray or these can be transferred to one of the orbital electrons. The ejection of the electron occurs through interaction of the electron and nuclear currents and charges through the electromagnetic field. Outside the region of nuclear transition currents and charges, the form of the field depends only on  $K$ ,  $L$ ,  $\pi$  and not on details of transition currents and charges. The rate of electron ejection depends on the electron wave-function and the form and strength of the E.M. field while the strength of the field is measured by  $\gamma$ -ray emission probability. The internal conversion coefficient,  $\alpha$ , which is the ratio of the rates of ejection of electron and  $\gamma$ -ray will depend, for a non-penetrating electron, on the electron wave-function and  $K$ ,  $L$ ,  $\pi$ . The effect of finite size of nuclear charge distribution (as against a point charge) on the Dirac wave-functions of the electron has been computed (Rose, Sliv) and their effects on I.C.C, particularly for  $M1$  type transitions, have been experimentally verified.

The electron, however, does penetrate the nuclear region a small fraction of time. This leads to the so-called dynamical penetration effects in internal conversion, as shown by Church and Weneser. The whole electric monopole,  $E0$ , mode of de-excitation occurs through such penetration effects, since there is no parallel  $\gamma$ -ray mode.  $E0$  transition is thus

the dynamical analogue of the static penetration effects as shown in volume effect in isotope shifts. It would, therefore, be of some interest to correlate data on isotope shifts and  $E0$  transition probabilities in nuclei, particularly in the 'deformed' region. While  $E0$  type of de-excitation alone is possible for  $O^+ \rightarrow O^+$  transitions, for transitions of type  $I \rightarrow I$ , with no change in parity,  $E0$  transition probability competes strongly with  $E2$  and  $M1$  types of transitions (Fig. 3) in heavy elements.

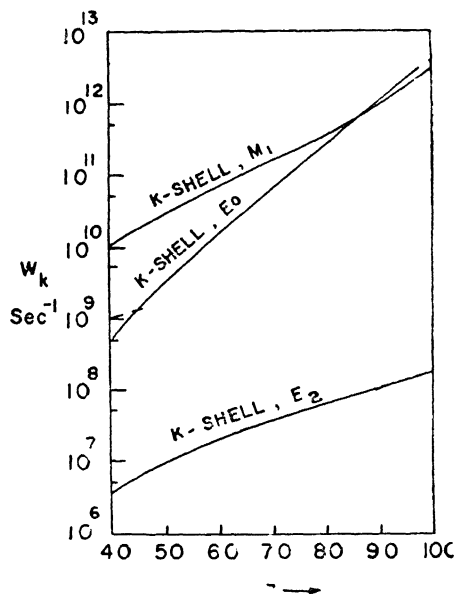


FIG. 3

It is, therefore, of great interest to search for second excited  $C^+$  levels in even isotopes of deformed nuclei and to look for variation of branching ratio  $E0/E2$  with the deformation parameter. In analogy with isotope shifts, this ratio should vary as  $\delta\beta^2/dN$ . There is some slight evidence for such a trend of variation in the values of  $E0/E2$  for the even isotopes of Gadolinium—Gd 152, 154 and 156. Adequate experimental data on this point are at present not available.

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## LETTERS TO THE EDITOR

## ULTRASONIC DISPERSION IN 1, 2-DICHLOROPROPANE VAPOUR

ONE of the authors (T.S.) studied the ultrasonic dispersion in 1, 1- and 1, 2-dichloroethane vapours<sup>1</sup> using the ultrasonic resonator interferometer in collaboration with late Dr. J. C. Hubbard. As it is desired to continue this work, an ultrasonic interferometer similar to the one used by Hubbard and his co-workers,<sup>2</sup> has been constructed in this laboratory and used for a study of ultrasonic dispersion in 1, 2-dichloropropane vapour. The purpose of the present note is to give a preliminary report of these experimental results.

The circles in Fig. 1 indicate the experimental points while the full line represents the theoretical curve. The upper and lower limits of the theoretical curve  $V_\infty$  and  $V_0$  are fixed by spectroscopic data.<sup>3</sup> The theoretical curve is obtained from the two limiting velocities making use of Kneser's formula on the assumption of a single relaxation frequency. The experimental points are in good agreement with the theoretical curve as can be seen from Fig. 1. The relevant relaxation constants are given in Table I.

It may be pointed out here that the ultrasonic dispersion in this vapour has been studied for

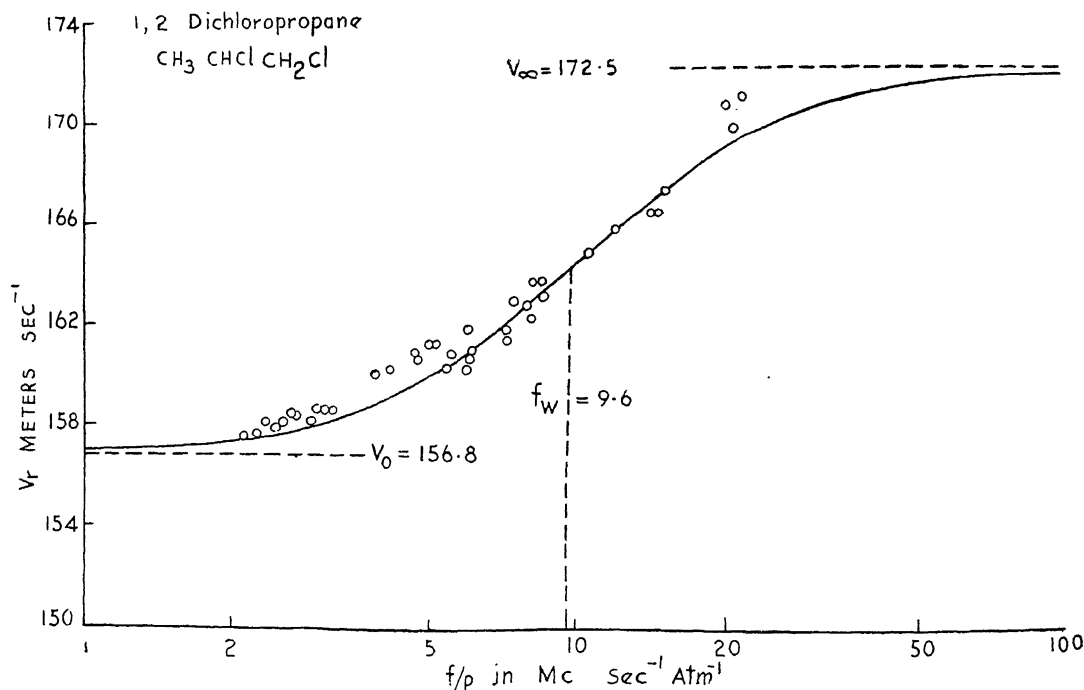


FIG. 1. Plot of  $V_r$  against  $\log f/p$  for 1, 2-dichloropropane vapour at 30° C.

Six X-cut quartz crystals of frequencies 200 kc., 400 kc., 500 kc., 800 kc., 1 Mc. and 2 Mc. sec.<sup>-1</sup> have been used covering the range of  $f/p$  from 2.75 to 31.35 Mc. sec.<sup>-1</sup> atmos.<sup>-1</sup>. The liquid used is a pure sample of laboratory reagent type obtained from British Drug House.

The values of velocities  $V_r$  are measured at 30° C. and are plotted against  $\log f/p$  in Fig. 1.

TABLE I  
Relaxation constants of 1, 2-dichloropropane vapour

Mc. Sec. <sup>-1</sup> Atmos. <sup>-1</sup>	V metres/sec.	Specific Heat— $C_v$
$f = 0$	$V_0 = 156.8$	$C_v^0 = 9.847$
$f_{10} = 9.6$	$V_{10} = 164.5$	
$f = \infty$	$V_\infty = 172.5$	$C_v^\infty = 3.000$

the first time. From the data given above the relaxation time  $\tau$  is calculated using the formula

$$\tau = \frac{1}{2\pi f_{10}} \frac{C_0^0}{C_0^\infty}$$

The value of  $\tau$  comes out as  $5.44 \times 10^{-8}$  sec. and this compares well, in order of magnitude, with the relaxation times obtained for similar polyatomic organic vapours given in the literature.

Full details of this work will be published elsewhere.

One of the authors (E.S.) is grateful to the Government of India for the award of a Junior Research Fellowship.

Department of Physics, T. SESHAGIRI RAO.  
Osmania University, E. SRINIVASACHARI.  
Hyderabad-7, July 12, 1962.

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O'Connor, C. L., *J. Acoust. Soc. Amer.*, 1954, **26**, 361.
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### SPIN OF THE 160 KEV-LEVEL IN TITANIUM-47

A LEVEL in  $Ti^{47}$  at 160 Kev has been established<sup>1</sup> to be populated following the decay of  $Sc^{47}$ . The ground-state spin of  $Ti^{47}$  has been measured<sup>2</sup> to be 5/2 and the parity is probably odd.  $Sc^{47}$  is known to decay *via* allowed transitions to both the ground-state of  $Ti^{47}$  and the 160 Kev excited level. This makes the spin of the  $Sc^{47}$  ground-state 3/2-, 5/2- or 7/2- with correspondingly similar assignments for the 160 Kev-level.

In order to throw more light on the spin of the 160 Kev-level studies on the decay of 31-minute  $V^{47}$  have been carried out.  $V^{47}$  has been known<sup>1</sup> to decay to the ground-state of  $Ti^{47}$ . This implies a spin assignment of 3/2-, 5/2- or 7/2- for  $V^{47}$  ground-state. The Q value for  $V^{47}$ - $Ti^{47}$  decay is 2.91 Mev.<sup>3</sup> Therefore there is plenty of energy available for decay to the 160 Kev-level by positron emission; earlier upper limit of 22% on the number of positrons per 160 Kev-photon seemed rather high.

$V^{47}$  was produced by a (p,n) reaction on natural Titanium. The single gamma-ray spectrum observed in a  $1'' \times 2''$  NaI counter revealed the presence of only annihilation radiation. The  $\gamma$ -ray spectrum in coincidence with positrons (annihilation radiation) was studied up to 600 Kev. Neither the 160-Kev photon

(nor any other) was observed in this energy range. An upper limit of 0.5% could be set on the number of 160 Kev-photons per positron yielding a log ft lower limit of 7.2.

It is difficult to understand the absence of  $V^{47}$  decay to the 160 Kev-level in spite of the large energy available and the presumably favourable spin situation. A way out of the difficulty would be to assign a spin of 7/2- to the  $V^{47}$  ground-state and 3/2- to the 160 Kev-level in  $Ti^{47}$ . This would make the decay to the latter level second forbidden and would account for the non-observance of branching. To complete the picture  $Sc^{47}$  may be assigned a spin of 5/2-.

Further studies are in progress to see if  $V^{47}$  decays to higher levels in  $Ti^{47}$ .

This work was performed while the author was at Ohio State University where he enjoyed fruitful discussions with Prof. P. S. Jastram.

Department of Physics, M. K. RAMASWAMY.  
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### POTENTIAL CONSTANTS OF HYDROXYLAMINE AND HYDROXYLAMINE- $d_2$

HYDROXYLAMINE is a non-planar molecule belonging to the  $C_s$  point group. Meyers and Lipscomb<sup>1</sup> established the trans-configuration through the X-ray studies.

Using the vibrational assignments given by Nightingale and Wagner<sup>2</sup> and the structural parameters suggested by Lecomte<sup>3</sup> and Lipscomb,<sup>1</sup> the potential constants of the molecules are evaluated separately for the hydrated and deuterated compounds employing Wilson's group theoretical methods<sup>4</sup> and a general valence force field.

The usual notation is employed in listing the constants in Table I.  $d$ ,  $r$  and  $s$  represent the H-N, N-O and O-H bond distances respectively.  $\theta$ ,  $\alpha$  and  $\phi$  represent the H-N-H, H-N-O and N-O-H bond angles respectively. The twisting co-ordinate is taken as  $\tau$  and is defined as half the sum of the two H-N-O-H twists. The internal co-ordinates  $\theta$ ,  $\alpha$ ,  $\phi$  and  $\tau$  are multiplied by  $d$ ,  $\sqrt{dr}$ ,  $\sqrt{rs}$  and  $r$  respectively so as to obtain all the potential constants in the same order of magnitude. The frequencies recalculated using these potential constants are found to agree well with the observed values.

TABLE I

Potential constant (in units of $10^5$ dynes/cm.)	H <sub>2</sub> NOH	D <sub>2</sub> NOD
$f_d$	5.5479	5.8515
$f_s$	5.1165	5.3639
$f_r$	3.9273	3.3872
$f_\theta$	0.2985	0.3983
$f_\phi$	0.5524	0.5896
$f_\alpha$	0.5535	0.3519
$f_r$	0.1398	0.1336
$f_{dd}$	-0.3315	-0.2865
$f_{ds}$	0.4120	0.2915
$f_{da}$	0.2473	0.2461
$f_{\theta\alpha}$	-0.0286	-0.1013

Differences are observed in the values of the corresponding potential constants of the two molecules, especially in the case of bending vibrations. Similar calculations on other hydrated and deuterated molecules are in progress. These also indicate similar deviations.

From the bond-stretching potential constants and Badger's empirical rule<sup>5</sup> the interatomic distances are recalculated and reported in Table II along with the assumed values.

TABLE II

Interatomic distance	Badger's rule		Assumed value
	H <sub>2</sub> NOH	D <sub>2</sub> NOD	
$d$	1.03	1.02	1.02
$s$	1.05	1.04	0.97
$r$	1.49	1.53	1.47

The authors are thankful to the authorities of the Sri Venkateswara University for the facilities provided.

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## DETERMINATION OF COPPER BY PHENYL PYRUVIC ACID OXIME

THE salt forming properties of the oximes have suggested their use as precipitants for various metals. These compounds form salts either by the replacement of the hydrogen atom of the oxime group or by the co-ordinating properties of the oxime nitrogen atom. In the case of copper, benzoinoxime<sup>1</sup> and salicylaloxime<sup>2</sup> are commonly used for its estimation.

It has now been found that phenyl pyruvic acid oxime in ethanolic solution, instantaneously forms a light blue precipitate of the complex with copper salts. The reaction is quantitative between pH 1.0 and 5.5.

Phenyl pyruvic acid was prepared using the method of Herbst and Shemin.<sup>3</sup> The acid was converted into its oxime by treatment with hydroxylamine hydrochloride at 0° C.<sup>4</sup> 3% solution of the oxime in ethanol was used for the estimations. Standard solutions of copper were prepared by dissolving copper sulphate (A.R., B.D.H.) in distilled water. pH of the solutions was adjusted by very dilute hydrochloric acid or ammonium hydroxide. For measurements of pH a Metrohm pH meter, model E-350, was used.

### PROCEDURE FOR DETERMINATION OF COPPER

A standard solution of copper sulphate, containing 10 to 30 mg. of copper, was diluted to about 100 ml. and pH of this solution was adjusted between 1.0 and 5.5 by hydrochloric acid or ammonium hydroxide. About 2 to 3 times the theoretical quantity of the reagent in ethanolic solution was added to it. A flocculent precipitate of the copper complex was instantaneously formed between pH 1.0 and 4.5. In those cases in which pH was between 4.5 and 5.5, initially the colour of the solution became deep blue and a precipitate began to appear after a few seconds. The precipitation in such cases was found to be complete in about five minutes. The precipitate was digested on a water-bath for about 15 minutes and then filtered through a sintered glass crucible No. 4. It was washed several times with 50% ethanol to remove excess of the reagent and finally dried at 110–115° C. in an oven. The results are given in Table I.

Copper could also be estimated by ignition of the complex to cupric oxide. After precipitation, the complex was filtered through Whatman filter-paper No. 42. It was ignited to oxide, the residue was treated with a little nitric acid to ensure complete conversion to cupric oxide and finally heated in an open crucible till

GeF <sub>4</sub>	..	740	200	800	260	4.0673	0.0488	0.2536	0.2084
AlCl <sub>4</sub>	..	349	146	180	575	2.3004	0.1278	0.0287	0.0040
TeBr <sub>4</sub>	..	190	51	64	209	1.4500	0.0192	0.0300	0.0040
InBr <sub>4</sub>	..	197	55	79	239	1.6410	0.0337	0.0219	0.0034
CdBr <sub>4</sub>	..	166	53	62	183	0.9447	0.0129	0.0430	0.0066
AlH <sub>4</sub>	..	1790	799	769	1741	1.7330	0.1113	-0.0200	-0.0030
BH <sub>4</sub>	..	2270	1065	1080	2270	2.9630	0.2159	-0.2159	-0.0016

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## PIGMENTS OF THE FLOWERS OF *HIBISCUS SURATTENSIS*

IN recent years, there has been some special interest in the field of flavonoids and many plant sources have been studied for the isolation of these compounds having specific physiological activities.<sup>1</sup> In view of the earlier observation<sup>2</sup> that gossypetin is highly potent for vitamin P activity and the report<sup>3</sup> that it is a good anti-oxidant for oils, certain *Hibiscus* and *Gossypium* species as sources of this pigment have been re-examined by Seshadri and co-workers.<sup>2</sup>

In continuation of our earlier work on the flowers of *Hibiscus tiliaceus*,<sup>4,5</sup> we have now investigated the pigments of the flowers of *Hibiscus surattensis*,<sup>6</sup> a study of which does not seem to have been reported earlier. The yellow parts of the petals of *H. surattensis* have been found to contain gossypitrin together with gossypetin, to an extent of about 0.1% and the purple-coloured portions cyanidin, delphinidin and traces of pelargonidin.

Following the procedure described earlier,<sup>5</sup> the yellow portions of the petals of fresh flowers of *H. surattensis* commonly found in and around Pondicherry (collected during October-November) were extracted with 95% alcohol, and the aqueous alcoholic concentrate was shaken with petroleum ether to remove the yellow carotenoid pigments and then with peroxide-free ether until no more colour was extracted. The ether layer on concentration deposited a greenish-yellow solid which on paper chromatography showed a prominent yellow zone, changing to greenish-blue on exposure to ammonia and with Rf values, 0.12 (phenol saturated with water, ascending), 0.23 (*n*-butanol : acetic acid : water = 4 : 1 : 5 *v/v* upper layer, ascending); 0.42 (acetic acid : water 6 : 4 *v/v*, ascending), 0.43 (phenol saturated with water, circular) and 0.62 (water saturated with phenol, circular), in close agreement with those reported<sup>4,7</sup> for gossypetin in the same systems.

The glycoside in the aqueous layer on paper chromatography gave only one zone and was

indicated to be gossypitrin by the Rf values in different solvent systems agreeing with those reported earlier.<sup>5</sup> It gave characteristic colour changes with alkaline solutions of different pH values and other colour reactions similar to those of gossypitrin and a negative Pew's reaction. The glycoside was then purified by chromatography on large sheets of filter-paper adopting the method described by Anyos and Steelink,<sup>8</sup> and the developed yellow zone (*n*-butanol-acetic acid-water) was cut and eluted with methyl alcohol. This eluate gave a prominent maroon colour with *p*-benzoquinone reagent, thereby confirming the presence of gossypitrin. Mixed chromatography with an authentic sample of gossypitrin showed no separation.

Further, the glycosidic solution (50% alcohol) on hydrolysis with 7% sulphuric acid yielded gossypetin, characterised by the preparation of its acetate, m.p. 226–28°, which remained undepressed when mixed with an authentic sample of gossypetin hexa-acetate. The sugar was identified as glucose by paper chromatography and preparation of its osazone, m.p. 208–09°. The identity of the pigment as gossypetin was finally established by deacetylation of the acetate and comparison of the colour reactions and co-chromatography with an authentic sample.

The lower purplish portion of the petals was studied for their anthocyanidin pigments according to the method of Bate-Smith.<sup>9</sup> The mixture of the anthocyanidins obtained after hydrolysis with 2N HCl was taken up in iso-amyl alcohol and subjected to large-scale paper chromatography. The three zones developed with 'Forestral solvent' (water : acetic acid : HCl = 10 : 30 : 3 *v/v*) were cut, eluted with 1% ethanolic HCl and individually studied by paper chromatography and their maximum absorption (Beckman Model B spectrophotometer). They were characterised as cyanidin,  $\lambda_{\max}$ : 545 m $\mu$ , Rf: 0.51 and 0.72; delphinidin,  $\lambda_{\max}$ : 555 m $\mu$ , Rf: 0.32 and 0.39 and pelargonidin,  $\lambda_{\max}$ : 535 m $\mu$ , Rf: 0.71 and 0.81 (Forestral solvent and *n*-butanol: 2N HCl = 1 : 1 *v/v* respectively) agreeing well with the values for these compounds reported earlier.<sup>9</sup> On a similar study, the lower (purplish) portion of the petals of *H. tiliaceus* contained cyanidin only.

We thank Prof. T. R. Seshadri for his kind interest in this work and Dr. S. G. Vengsarkar, Principal, Medical College, Pondicherry, for encouragement.

Medical College,	A. G. R. NAIR.
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TABLE I

Estimation of copper by weighing the complex

Wt. of Cu <sup>++</sup> taken in mg.	pH	Wt. of the complex (found) in mg.	Wt. of the complex (calc.) in mg.
10	1.0	66.0	66.03
10	1.2	66.2	66.03
15	1.5	99.0	99.045
10	2.8	66.3	66.03
25	3.8	165.4	165.075
30	4.5	198.0	198.09
20	5.5	132.2	132.06

constant weight was attained. The results of some of the estimations are given in Table II.

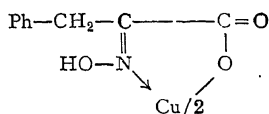
TABLE II

Estimation of copper by weighing the oxide

Wt. of Cu <sup>++</sup> taken in mg.	pH	Wt. of the oxide (found) in mg.	Wt. of the oxide (calc.) in mg.
20	1.0	25.00	25.036
20	1.2	25.02	25.036
20	2.8	25.02	25.036
20	4.5	24.98	25.036
20	5.5	25.00	25.036

## STRUCTURE OF THE COMPLEX

From Table I it can be seen that two molecules of oxime combine with one atom of copper. The structure of the complex can, therefore, be represented as:—



In the above structure, it is assumed that the ionizable hydrogen atom of the carboxyl group in the oxime molecule is replaced by a copper atom. The nitrogen atom of the oxime group co-ordinates with the metal atom.

To establish the above structure, the oxime

of phenyl pyruvic acid ester was prepared. It was found that this does not form a complex with copper. It is, therefore, evident that the hydrogen atom of the carboxyl group and not of the oxime group undergoes replacement during complex formation.

The oxime also gives precipitates with other cations such as Ni<sup>++</sup>, Co<sup>++</sup>, etc. Further investigations concerning estimations of these cations are in progress.

The authors are grateful to Prof. T. R. Seshadri, F.R.S., for his keen interest and helpful discussions.

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### ORBITAL VALENCE FORCE CONSTANTS OF TETRAHEDRAL XY<sub>4</sub> TYPE MOLECULES

The force constants of tetrahedral XY<sub>4</sub> type molecules have been calculated using orbital valence force field introduced by Heath and Linnett.<sup>1</sup> This type of molecules, belonging to the point group T<sub>d</sub>, has 1a<sub>1</sub> + 1e + 2f<sub>2</sub> vibrations. The constants K, K<sub>a</sub>/(r<sup>0</sup>)<sup>2</sup>, A and B/R<sup>0</sup>, corresponding to stretching, bending and repulsion constants respectively, are calculated from the four observed frequencies. The observed frequencies and the values of the force constants obtained are given in Table I.

The author wishes to thank the Council of Scientific and Industrial Research, Government of India, for the award of a Junior Research Fellowship.

TABLE I

Fundamental frequencies and force constants of tetrahedral XY<sub>4</sub> molecules.

Molecules	Frequencies in cm. <sup>-1</sup>				Force constants (10 <sup>5</sup> dynes/cm.)				
	σ <sub>1</sub>	σ <sub>2</sub>	σ <sub>3</sub>	σ <sub>4</sub>	K	K <sub>a</sub> /(r <sup>0</sup> ) <sup>2</sup>	A	B/R <sup>0</sup>	
GeF <sub>4</sub>	..	740	200	800	260	4.0673	0.0488	0.2536	0.2084
AlCl <sub>4</sub>	..	349	146	180	575	2.3004	0.1278	0.0287	0.0040
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### ENERGY AND ENTROPY OF ACTIVATION OF REACTION BETWEEN MANGANIC PYROPHOSPHATE AND TARTARIC ACID

THE oxidation of tartaric acid and manganic pyrophosphate has been recently investigated by Levesley and Waters.<sup>4</sup> Their mechanism of oxidation suggests that the rate-determining step involves a unimolecular process. However, no data are available on the frequency factor of this reaction. The present investigation was, therefore, undertaken to determine the energy of activation, frequency factor and entropy of activation of the reaction with a view to throw more light on the mechanism of oxidation of tartaric acid by manganic pyrophosphate.

The reaction between tartaric acid and manganic pyrophosphate was studied at temperatures 26.1°, 30.5°, 34.7° and 39.6° C. and at pH = 1.0. All reagents used were of 'AnalaR' specifications. Manganic pyrophosphate was prepared by the method of Lingane and Karplus.<sup>5</sup> Sodium sulphate was used to maintain ionic strengths of the solutions constant. Requisite quantities of the reacting substances were brought to thermostat temperature ( $\pm 0.01^\circ$  C.) and then mixed in reaction vessel also kept at the same temperature. Aliquots were withdrawn at known intervals of time and rapidly added to potassium iodide solution. The iodine liberated was rapidly estimated with standardised solution of sodium thiosulphate taking precautions to avoid air oxidation of iodide.<sup>3a, b</sup>

The reaction was found to obey first-order rate law with respect to Mn (III) up to 50% of the reaction; after which the rate constants were found to fall off, probably due to retardation by manganous ions produced during the

course of the reaction.<sup>4</sup> The rate laws may be expressed as

$$-\frac{d[\text{Mn(III)}]}{dt} = \frac{k[\text{Tartaric acid}][\text{Mn(III)}]}{\{a + [\text{Tartaric acid}]\}} \quad (1)$$

$$= k_1[\text{Mn(III)}]$$

where

$$k_1 = \frac{k[\text{Tartaric acid}]}{\{a + [\text{Tartaric acid}]\}} \quad (2)$$

The value of 'a' was obtained from a plot of inverse of  $k_1$  against inverse of tartaric acid concentration. This value comes out to be 0.047 and agrees well with the value of 'a' = 0.044 obtained by Levesley and Waters.<sup>4</sup>

The specific rates at different temperatures were calculated using equation (2). These are summarised in column 3 of Table I.

TABLE I

Initial [Mn (III)] =  $8.33 \times 10^{-3}$  M; Total [Pyrophosphate] = 0.112 M; Initial [Tartaric acid] = 0.20 M; pH = 1.0;  $\mu = 0.50$

Temperature ° Absolute	$k_1 \times 10^4$ sec. <sup>-1</sup>	$k \times 10^4$ sec. <sup>-1</sup>	$\Delta E$ k. cal.	$pZ \times 10^{-11}$ sec. <sup>-1</sup>	$\Delta S$ e.u.
299.1	3.00	3.69	20.16	2.21	-7.6
303.5	4.11	5.05	..	2.16	..
307.7	7.74	9.53	..	2.18	..
312.6	13.16	16.19	..	2.28	..
Average			..	2.21	

A plot of log of specific rate constant,  $k$ , against inverse of absolute temperature gives a straight line. Arrhenius equation is, therefore, valid. The value of energy of activation,  $\Delta E$ , calculated from the slope of the straight line, comes out to be 20.16 k. cal. This value of energy of activation corresponds to C—C bond fission *via* co-ordination (cf. Duke<sup>1</sup>) and supports the Levesley-Waters scheme for oxidation of tartaric acid. Using this value of energy of activation, frequency factor,  $pZ$ , was calculated for the reaction at various temperatures. The values of this factor are given in column 5 of Table I. The value of entropy of activation for the reaction works out to be -7.6 e.u. The experimental values of  $\Delta S$  and  $pZ$  factor accord with the Levesley-Waters scheme which involves the decomposition of a complex formed between manganic pyrophosphate and tartaric acid, as the rate-determining step. The negative value of  $\Delta S$  is to be expected, if a cyclic intermediate is formed from non-cyclic reactants.<sup>2, 6</sup>

Levesley-Waters scheme for oxidation of tartaric acid may, therefore, be considered as established.

One of us (R. S.) is grateful to the Ministry of Scientific Research and Cultural Affairs for grant of a research scholarship which made this work possible.

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Government College, G. V. BAKORE.  
Ajmer, April 20, 1962.

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### UNCONFORMITY BETWEEN THE LOWER AND THE UPPER MURREES IN JAMMU PROVINCE, JAMMU AND KASHMIR STATE

THE Murree Series has been divided into two groups, the Lower Murrees and the Upper Murrees (both of Lower Miocene age). The Murrees of Poonch District were originally briefly described by Wadia (1928); the Series has become firmly entrenched in the Indian geological nomenclature.

Wadia (1957, p. 352) mentions that Murree Series is composed of shales, sandstones and pseudoconglomerates in the Lower group and shales and sandstones in the Upper group. Thus, there is no striking lithological dissimilarity between these two groups. According to him, structurally, however, the Lower Murrees are characterised by a great amount of compression, fracture and dislocation, being plicated in a series of tight isoclines and overfolded with repeated local faulting. The Upper Murrees are thrown into open, broad folds weathered into strike ridges and valleys with a succession of escarpments and dip slopes.

During the geological mapping in the Rajaori (33° 22' 30" : 74° 19') and Naushera (33° 09' 30" : 74° 14' 30") *Tahsils* of Jammu Province, the writer studied the Murrees in some detail. The stratigraphic thicknesses of the two groups were measured in the section along the Naushera-Rajaori road. The Lower Murrees consist of alternating bands of purple and green

clay and sandstone and have a total thickness of 746 metres. The clay : sandstone ratio in them is 3.7 : 1. The Upper Murrees, which have a thickness of 690 metres, also consist of bands of clay and sandstone, but in the proportion of 6.5 : 1.

The point to which I would like to draw particular attention is that during the present work, the existence of an unconformity between the Lower and the Upper Murrees was recognised for the first time, while the Murree sequence was considered conformable in all previous accounts. The recognition is based on field relationships and differences in the intensity and types of fold patterns in these two groups. The plane of unconformity has a gentle northerly dip and is exposed at a variable height on the southern slopes of the ridge immediately to the north of the Sunderbani (33° 03' : 74° 30')—Naushera road. The Lower Murrees are thrown into tight folds, and the bedding dips have no fixed relationship with the plane of unconformity. The Upper Murrees are thrown into broad open folds and the bedding dips adjacent to the unconformity are generally parallel to its trend. Even the topographic expression of the Lower and the Upper Murrees is strikingly different. Some local bands of conglomerate are seen at the base of the Upper Murrees, as in the area south-west of Pathradi (33° 10' : 74° 18' 30").

The unconformity in the Murrees seems to represent a time interval during which the Lower Murrees were folded and eroded.

The Murree rocks are considered potential reservoir rocks for petroleum. Many isolated gas or oil seepages are reported in these rocks in the Jammu Province. Considerable work is in progress to assess the presence of oil and gas in these rocks. The unconformity between the Lower and the Upper Murrees is of importance and has to be kept in mind in considering the different aspects of the possible accumulation of petroleum in the Murree rocks.

Ahmedabad,  
June 25, 1962.

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Gujarat State.

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# NOTE OF HEAVY MINERAL CLASSIFICATION OF SIWALIK SEDIMENTS FROM JAMMU AND THE PUNJAB (INDIA)\*

TERTIARY sediments exposed in Jammu and Jawalamukhi, Dharmasala, Mandi, Bhakra-Nangal and Janauri areas of the Punjab have been studied for heavy detrital minerals. Nearly 5,000 samples belonging to Upper, Middle and Lower Siwaliks, Dharmasala beds and Subathus have been examined. From the study it is observed that broad regional as well as detailed local correlation of the Siwalik sediments may be successfully attempted based on heavy mineral assemblages. The mineral assemblages of various groups of sediments are shown in Fig. 1.

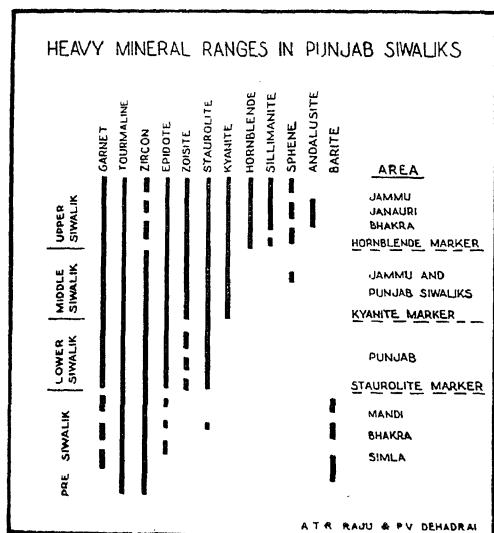


FIG. 1

Staurolite, kyanite, hornblende, sillimanite, andalusite and spinel have restricted vertical distribution in the Siwaliks and serve as positive mineral markers for different horizons. Staurolite, kyanite and hornblende have regional significance in as much as they could be traced from Jammu in the north-west to as far as Mohand (near Dehra Dun) in the south-east and have been found useful as regional markers. It may be noted (Fig. 1) that the pre-Siwaliks of the Punjab contain an essentially stable assemblage of garnet, zircon and subrounded tourmaline with occasional flooding of barite, whereas the Lower Siwaliks contain staurolite and epidote besides garnet, tourmaline, zircon, etc. Increase in complexity of heavy

assemblages in younger beds is also well established and is in conformity with observations in other parts of the world.<sup>1</sup> Kyanite is a marker (by its presence) for the Middle Siwaliks and hornblende, sillimanite and andalusite are characteristic constituents of the Upper Siwalik sediments.

Besides the positive mineral markers quantitative variations in individual mineral percentages, morphological features of certain minerals like etching of garnets, concertina variety of staurolite, rounded nature of tourmaline and colour characters like pistachio green variety of epidote, indigoblue variety of tourmaline help in establishing local correlations. Examination of the heavy assemblage along with the study of light crops have helped in tracing the provenance of the sediments. The textural and mineralogical variations in sandstones also help in palaeogeographic interpretations.

The object of this note is to show that correlation of Siwaliks based on heavy mineral characters has been found useful in classifying the Siwaliks of the Himalayan foot hills.

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Dehra Dun, June 29, 1962.

\* Published with the kind permission of Director of Geology, Oil and Natural Gas Commission, Dehra Dun. The views expressed in the note are of the authors only and not necessarily of the O.N.G. Commission.

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## STATISTICAL SLOPE ANALYSES OF THE RAGHUNATH PALEM HILL

WITH typical phyllites and quartzites, the hill South of Raghunath Palem (long. 80° 12', lat. 17° 17'), Khammam District, Andhra Pradesh, forms a part of the southern extension of the famous metasediments of Pakhal formations. The rocks here are highly metamorphosed and sharply folded. Keeping in view its structural importance, a contour map of the scale 6" = 1 mile, with a contour interval of 5' has been prepared and on the basis of the method developed by Chapman<sup>1</sup> a Statistical Slope Orientation diagram is made and the interpretation is given through the diagrams. In this method the orientation of slopes in space is statistically represented in which respect it is analogous to the petro-fabric diagram wherein the Orientation of mineral grains within a rock are shown statistically.

Using traverse method, 325 slope measurements are made throughout the map with the help of a specially constructed scale meant for the purpose and are plotted and contoured. In this SSO diagram, besides major features of the

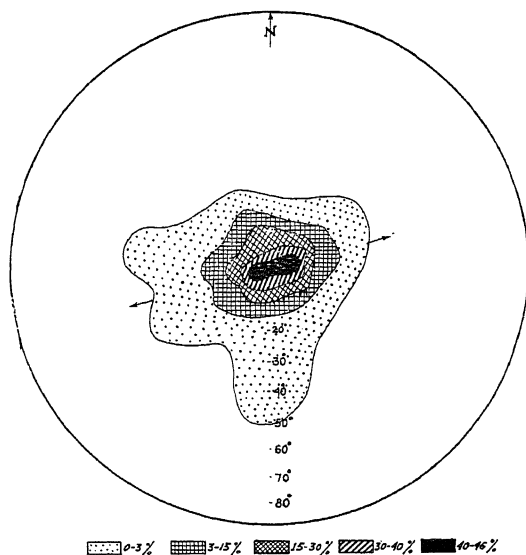


FIG. 1. SSO DIAGRAM, HILL, SOUTH OF RAGHUNATH PALEM. ARROW INDICATES THE EXTENSION DIRECTION OF THE MAXIMA.

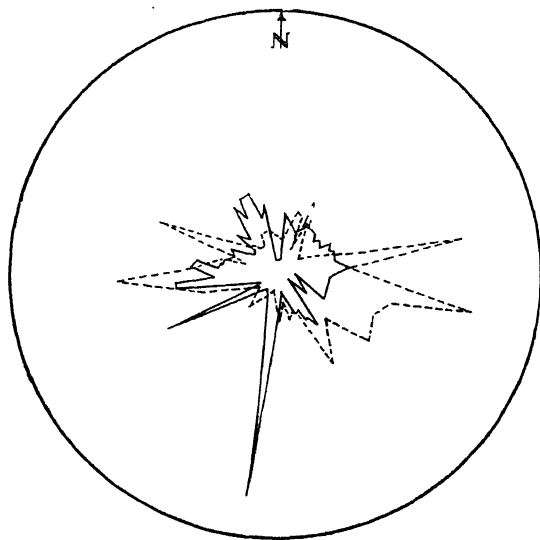


FIG. 2. Diagram showing the frequency of the average slope angle (solid line) and frequency of slope orientation (dotted line).

contour map, minor features also become conspicuous. The maximum concentration of 40-46% is confined to the central part of the

diagram, thereby indicating its low elevation (in fact about 90' from ground level). The symmetry of the diagram is essentially triclinic. The maxima roughly extend in the direction NEE-SWW thereby giving a strike direction slightly West of North. This can also be seen from the average slope angle curve of Fig. 2. The frequency curve of the average slope angle also extends roughly in the direction N 85° E to N 100° E and the two minima are reached in the direction perpendicular to this. It is interesting to note that the direction of minima corresponds fairly well with the measured strike direction which is 10°-20° West of North and roughly parallels the strike of the regional foliation of Pakhals which is N 25° W and in general with the strike of the hill range itself. In the slope angle curve, the protuberance in the South and the depression in the North indicate cliff and slope respectively present in the hill. Frequency of the slope orientation diagram shows that large number of slopes dip in the direction 80°-110° and about 270°. Though this curve approximately corresponds to that of the slope angle there can be minor deviations seen. In the hill majority of the slopes dip by about 8° and few exceed 20°, a fact well exhibited by the slope angle curve.

The authors are thankful to Dr. S. Balakrishna for valuable suggestions.

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Osmania University, CH. SUDARSANA RAJU.  
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### DECAYED WOOD FLOUR AS EXTENDER FOR PHENOL- FORMALDEHYDE RESIN ADHESIVES

MACLEAN AND GARDNER (1953) found that addition of a 1.5% sodium hydroxide extract of Western red cedar butt rot could replace 50% of the phenol-formaldehyde resin in a plywood glue with very good results; also, that at the 50% level the butt rot flour could substitute walnut shell flour as extender for phenol-formaldehyde resin adhesives for plywood. The butt rot samples used by these authors had a very low carbohydrate content and consisted mainly of lignin or partially demethylated lignin. Narayana-murti and George (1954) studied the production of boards and plastics from sawdust and found that fungus-attacked sawdust could be moulded under heat and pressure to give products of satisfactory strength and good water resistance. In their early experiments they used wood

samples decayed by brown rot fungi and having very high lignin content. The results of experiments on the use of a similar material as a filler and extender for phenol-formaldehyde resin adhesive is now reported.

The material for these tests was taken from a log of *Sapium baccatum* in an advanced stage of decay by brown rots. Pieces of wood removed from the log crumbled easily in the hand

Forest Research Institute, D. NARAYANAMURTI,  
Dehra Dun, April 26, 1962. JOSEPH GEORGE.  
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TABLE I

Test results on p-f resin extended with decayed wood flour

S. No.	Spread of p-f resin, g./sq. m.	Weight of extender on solid resin, %	Glue		Adhesion		8 hours' boiling	
			Dry		3 hours' boiling		8 hours' boiling	
			Failing load, kg.	Glue failure %	Failing load, kg.	Glue failure, %	Failing load, kg.	Glue failure, %
1	108	0	192	47	192	52	213	40
2	86	25	173	39	149	22	189	10
3	81	33	195	15	185	67	191	83
4	72	66	192	10	193	62	204	63
5	54	100	186	57	123	100	154	100
6	36	200	125	81	108	100	73	100
Requirements of IS : 303, 1951		MPF I	136	..	102	..	..	..
		MPF II	113	..	91	..	..	..

indicating near complete destruction of carbohydrates.

The decayed wood was air-dried and powdered to pass through an 80-mesh screen. The flour was mixed with a water-dispersible variety of phenol-formaldehyde resin and painted on *Canarium* veneers. After conditioning to a moisture content of about 8%, the veneers were pressed at 150° C. and 17 kg./sq. cm. for 10 minutes into 3-ply plywood panels.

The plywood panels were conditioned in the laboratory for about a week and were then tested for glue adhesion strength according to Indian Standard specification for moisture-proof plywood (IS: 303, 1951). The glue adhesion strength after 8 hours boiling of test specimens was also determined. The results are given in Table I.

The figures show that decayed wood flour gives good results up to 100% extension. The glue adhesion strengths are well above the requirements for moisture-proof plywood, grade 1. The amount of phenol-formaldehyde resin used per sq. metre of joint has at the same time been brought down from the usual value of about 108 g./sq. metre to 54 g./sq. metre. Even after 8 hours' boiling, the joints had very high strength. At 200% extension, the joint strengths meet the requirements of moisture-proof plywood, grade II.

### CHLOROPHYLL CONTENTS OF MARINE ALGAE FROM SAURASHTRA COAST

WILLSTATTER and STOLL<sup>1</sup> in 1913 determined the chlorophyll content of *Ulva lactuca* and found the chlorophyll contents of marine algae of the ratio of chlorophylls  $\alpha$  to  $\beta$  to be 1.3. Later different regions were reported by Willstatter and Page, Lubimenko, and Seybold and Egle.<sup>1</sup> No such data are available for the chlorophyll contents of Indian marine algae. The total chlorophyll and chlorophylls  $\alpha$  and  $\beta$  of some algae from Saurashtra Coast have been determined in this Institute and the results are reported in this note.

Samples of green algae were collected from Porbandar, Veraval and Okha on the Saurashtra Coast and analysed for chlorophylls  $\alpha$  and  $\beta$  by the method of C. L. Comar (A.O.A.C. methods of analysis).<sup>2</sup> Chlorophyll was repeatedly extracted from 1-2 gms. of air dried algal material to which was added 0.1 gm. of calcium carbonate with 85% acetone until the residue was free from green colour. The chlorophyll was re-extracted into ether layer from the acetone extracts and made upto a known volume. A suitable quantity of the extract was dehydrated with anhydrous sodium sulphate, and the absorbency was measured at 660 m $\mu$  and 642.5 m $\mu$  respectively in a Hilger Uvispec spectrophotometer, using

TABLE I

Algæ	Place and Date of collection	Chlorophyll content (in mg./100 gm. of air-dried material)			Ratio $\alpha : \beta$
		Total	$\alpha$	$\beta$	
<i>Caulerpa</i> sp.	Veraval 10-4-1962	355.9	174.2	182.4	0.955
<i>Caulerpa racemosa</i> (Forskal) J. Agardh var. <i>uvifera</i> (Turner) W. V. B.	do.	203.5	103.3	105.5	0.981
<i>Caulerpa sertularioides</i> (Gmelin) Howe.	Porbandar 10-4-1962	163.5	86.62	76.95	1.13
<i>Chamædoris auriculata</i> Boergs.	Veraval 10-4-1962	124.8	85.35	40.47	2.1
<i>Cladophora saviniana</i> Boergs	Okha 7-5-1962	177.4	87.32	89.78	0.973
<i>Codium dwarknese</i> Boergs.	Okha 8-4-1962	63.63	34.64	29.16	1.19
do.	Porbandar 10-4-1962	75.75	51.45	24.24	2.123
<i>Halimeda tuna</i> (Ellis and Solander) Lamouroux.	Okha 7-5-1962	354.2	183.1	172.8	1.06
<i>Udotea indica</i> A. and E.S. Gepp.	do.	149.2	74.69	74.11	1.01
<i>Ulva fasciata</i> Delile.	Veraval 10-4-1962	184.7	81.32	103.7	0.784
<i>Ulva lactuca</i> Linnaeus.	Okha 8-4-1962	14.96	6.179	5.673	1.09
<i>Ulva rigida</i> (C. A. Agardh) Le Joli	Gopinath March, 1962	162.2	95.96	66.25	1.45

ether in the reference cell. Total chlorophyll, chlorophylls  $\alpha$  and  $\beta$  were calculated from absorption data using the equations of Comar.<sup>3</sup> Results are given in Table I.

Among the algæ examined *Caulerpa* sp. contains the maximum amount of total chlorophyll while *Ulva lactuca* has the minimum quantity. *Caulerpa sertularioides*, *Chamædoris auriculata*, *Codium dwarknese*, *Halimeda tuna*, *Ulva lactuca* and *Ulva rigida* all contain a higher percentage of chlorophyll  $\alpha$  than chlorophyll  $\beta$  while the rest have higher proportions of chlorophyll  $\beta$  excepting *Udotea indica*, which contains almost the same quantities of chlorophyll  $\alpha$  and  $\beta$ . Of the three *Ulvas* examined the total chlorophyll content of *Ulva lactuca* was less than one-tenth of that present in the other two. *Caulerpa* sp. has a much higher percentage of total chlorophyll than *sertularioides*.

Specimens of *Codium dwarknese* Boergs. collected from Okha and Porbandar show a marked difference between themselves in the ratios of chlorophylls  $\alpha$  and  $\beta$ , although the total chlorophyll contents in the two are not far different.

The authors' thanks are due to Dr. (Mrs.) F. Thivy and the members of the Algology Section of this Institute for the collection and identification of species.

Central Salt and Marine  
Chemicals Research  
Institute,  
Bhavnagar, July 11, 1962.

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V. SITAKARA RAO.  
K. SYAMA SUNDAR.

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## TWO CASES OF BACTERIAL DISCOLOURATION OF SQUIDS

WHILE working in the Toklai Regional Fisheries Research Laboratory, the author came across two instances of discolouration of the squid *Omnastrephes sloanii pacificus*. In the first instance, the squid, stored at 4° C. after treatment with O.T.C. (oxytetracycline), developed yellow discolouration. In the second instance the same sample kept at room temperature developed red discolouration. On microscopic examination, the discolouration was noticed to be due to motile bacteria. The organisms were cultured, isolated and purified by the approved methods and from pure cultures, sterile pieces of squid were inoculated. The yellow and the

red discolouration were developed on the pieces. From these latter, the bacteria were again isolated for study.

The bacterium producing yellow discolouration is described below: Rods actively motile with a single polar flagellum, gram negative, non-sporing. Agar stroke, cream yellow beaded, raised. No acid or gas from glucose, sucrose or lactose. Acid but no gas from arabinose; good growth and sediment in broth,  $\text{NH}_3$  produced; gelatin not liquefied; indole and  $\text{H}_2\text{S}$  not produced; nitrate not reduced; milk not coagulated; reduced trimethylamine oxide at  $4^\circ\text{C}$ . and at  $20^\circ\text{C}$ . but not at  $30^\circ\text{C}$ . Citrate positive; amylase positive; tolerates up to 100 p.p.m. of O.T.C., but not 125 p.p.m. The bacterium concerned resembles *Pseudomonas putida*.

Reddening due to halophilic bacteria<sup>1</sup> is known but in unsalted material, this is not known. The bacterium which produced red discolouration of the squid is described below:

Rods small, single, motile with peritrichous flagella. Gram negative asporogenous. Agar colonies circular, entire, smooth, glistening, raised 0.5 mm. Red magenta chromogenesis. Agar slope, filiform to beaded, with villous margin. Acid and gas from glucose but none from sucrose, lactose, arabinose; milk coagulated slightly acid; reductase present;  $\text{NH}_3$  from peptone; uniform high turbidity in broth, red ring and sediment. Strong odour of trimethylamine. Gelatin rapidly liquefied;  $\text{H}_2\text{S}$  produced from Kligler iron agar; Koser citrate positive. Nitrate reduced to nitrite; reduces TMAO to trimethylamine rapidly; growth at  $4^\circ\text{C}$ . negative up to 26 days; aerobic facultative; pigment soluble in water, insoluble in benzene. Resists 400 p.p.m. O.T.C. The organism appears to be a strain of *Serratia marcescens*.

Discolouration of fish due to *Pseudomonas* infection has been recorded<sup>2</sup> earlier but the type of yellow discolouration recorded here appears to be new. Tolerance of such high concentration of O.T.C. as 100 p.p.m. by *Pseudomonas* sp. is not reported and will have grave implications in preservation of fish with antibiotics. Castell<sup>3</sup> has described the spoilage of fish fillets caused by *Ps. putrefaciens*. Vaughn *et al.*<sup>4</sup> have recorded that some strains of *Pseudomonas* isolated from poultry meat tolerated 480 p.p.m. O.T.C. after "training" but that before "training" the tolerance limit was never more than 15 p.p.m. The organism described in this note as resembling *Ps. putida* appears to be a potential spoilage organism. Similarly tolerance by *Serratia* strain of 400 p.p.m. of O.T.C. is unusual, as this

is known to tolerate only 200 p.p.m. of this antibiotic.<sup>5</sup>

My thanks are due to Dr. K. Amano for his helpful suggestions and to Sri. H. K. Ghazi, Director of Fisheries, Madras, for his interest and for permission to publish this note.

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### INQUILINISM BETWEEN A NEW HESIONID POLYCHAETE AND A HOLOTHURIAN *MOLPADIA* SP.

WHILE examining a holothurian *Molpadia* sp. in the Kakinada Bay for parasitic molluscs we have frequently come across a hesionid polychaete living in its intestine. This is the first report, as far as we are aware, of a polychaete in the alimentary canal of an echinoderm. Two specimens of the worm were sent to Mr. F. Rullier, for identification and he named it *Ancistrosyllis groenlandica* McIntosh (Rullier, 1960). He suspected that the worm might have been accidentally ingested by the holothurian and attributed the differences in the characters between the present form and the type species of the genus to the partly digested condition of the worm. Since sending the specimens to Mr. Rullier we have been able to collect several more specimens of the polychaete and we are convinced that the association between the worm and the holothurian is not accidental but one coming under a special type of association called inquilinism (Dales, 1957), in which one organism lives within another, usually in some part of the alimentary tract or respiratory chamber without being parasitic on it or causing it any serious harm. We also feel that the worm on careful examination does not fit into any of the described hesionids in all its features and as such we are describing it elsewhere as a form new to science.

Almost 50% of the holothurians examined harboured the worm in the intestine. Usually a single adult worm is present though we have found on a few occasions a young worm also in addition to an adult. The worms were all



alive and active. It is interesting that even though we have made a large number of dredge collections from the same location where the holothurian lives, we have not so far succeeded in getting even a single free living specimen of the polychaete. We are therefore convinced that this is a clear case of inquilinism and not a case of accidental ingestion of the polychaete by the holothurian as previously reported by Rullier (1960).

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#### OCCURRENCE OF *CLEANTIS NATALENSIS* ON THE WEST COAST OF INDIA

*Cleantis natalensis* Barnard (Isopoda: IDOTEIDAE) was first described in 1925.<sup>1</sup> Subsequently Barnard<sup>2</sup> (1936) recorded adults of this species, inhabiting tubular cases, from the Ganjam Coast, Orissa and also from Burma (Bassein River estuary). In a later publication,<sup>3</sup> the same author said that the juveniles from which the species was first described probably reached the Natal Coast in drift-weed; and he gave its distribution as Bay of Bengal.

In 1956, five specimens of *C. natalensis* were collected from the intertidal regions of Bombay, during the rainy season; and this is the first record of this species from the West Coast of India. One ovigerous female of 19 mm. length and a juvenile of 5 mm. were obtained from a log of wood which was heavily attacked by Teridinid borers; and the isopods were found in a tube, in one of the excavations. Another ovigerous female of 13 mm. was found in a puddle in sand among rotting leaves. Two forms (2 and 3.5 mm. long respectively) were collected from Euniceid tubes, while the fifth specimen, of 9 mm., was found among barnacles and oysters on a rocky shore.

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#### CHROMOSOME NUMBER OF *LACCIFER LACCA* (KERR.) (KUSMI STRAIN) HOMOPTERA—COCCOIDEA

SURVEY of literature reveals that the chromosome number of the lac insect, *Laccifer lacca*, still remains undetermined. The present note embodies preliminary observations on the chromosome number and structure and the nature of the kinetochore. Chromosome counts were made from cells of developing embryos, nerve tissue and also of the tracheal wall of the female.

For cytological studies, lac insect offers three main difficulties: (a) A hard encrustation of lac resin around the body; (b) possession of a tough and impermeable cuticular covering; (c) presence of reddish body fluid (lac dye) which comes in the way of making good preparations. To overcome these difficulties and to obtain good cytological preparations, the usual methods of fixation were slightly modified. Lac insects removed from host plants were quickly dissected out in a drop of fixative. On removal, the ovarioles were kept in Carnoy's fluid for 2-4 minutes at 60° C. Bleaching of the ovarioles with  $\text{KMnO}_4$  and sulphurous acid helped to a slight extent to get rid of the lac dye. Ovarioles stained better when left in aceto-orcein for 10-12 minutes at 60° C. Sanfelice-haematoxylin and Carnoy-Feulgen-light-green preparations were also made.

A diploid chromosome number of 18 was found in all the different types of cells. The chromosomes are rod-like, presenting some variation in regard to their size. Based on observations using the oculometer for measurement of chromosomes, they could be grouped into 8 large, 8 medium and 2 small chromosomes (Fig. 1).

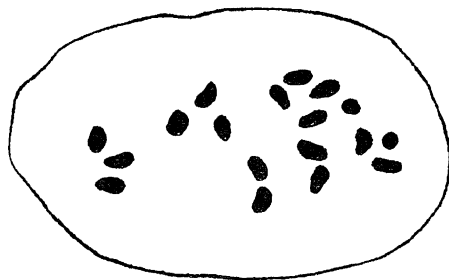


FIG. 1. Mitotic-metaphase in the cells of the ovariole. Aceto-orcein preparation drawn with the aid of Camera Lucida at table level. Ca.,  $\times 1455$ .

The kinetochore of *Laccifer lacca* appears to be diffuse in nature as in other Coccid chromosomes described by Hughes-Schrader<sup>1-3</sup>

and Schrader.<sup>4</sup> This suggestion is based on the fact that the chromosomes at anaphase of mitosis move towards the poles in parallel fashion.

I wish to express my deep gratitude to Prof. B. R. Seshachar, Department of Zoology, University of Delhi, for his kind criticisms and suggestions and to Dr. M. S. Muthana, the Director of the Institute, for his constant encouragement.

Division of Entomology,  
Indian Lac Research Institute,  
Namkum, Ranchi, Bihar.  
May 18, 1962.

S. DIKSHITH.

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### ON THE CELLULOLYTIC PROPERTIES OF THREE SPECIES OF *STREPTOMYCES*

THOUGH many cellulolytic fungi and bacteria have been studied there are only a few reports on *Streptomyces* spp. in this regard.<sup>1-3</sup> In the course of our studies on the biochemical grouping of *Streptomyces* spp. from the rhizospheres of citrus and rice plants a large number of cellulolytic forms were noted. Three of the isolates which showed relatively more activity than the others in decomposing cellulose were studied and the results are reported here.

The isolates were identified as *Streptomyces bikiniensis* Johnstone and Waksman, *S. olivaceus* (Waksman) Waksman and Henrici and *S. albus* (Rossi-Doria emend. Krainsky) Waksman and Henrici.<sup>4</sup> The relative efficiency of the three species to reduce cellulose was tested following the procedure adopted by Bose and Ghose,<sup>5</sup> using Czapek-Dox solution to which 3% W/V of dried prosopis fruit coat (containing 16.4% cellulose), 1% filter-paper pulp or 1% pure cellulose (Biochemical Laboratory Suppliers, Bombay) was added. 75 ml. of the culture medium was taken in 250 ml. Erlenmeyer flasks and the *Streptomyces* sp. inoculated. The flasks were incubated at room temperature (28–30°C.) for 20 days and the reduction percentage in the cellulose estimated. The results (Table I) showed that *S. olivaceus* was relatively more active in reducing the three types of cellulose.

When they were cultured in Czapek-Dox medium with 2% pure cellulose under static and submerged aerated cultures on shakers and

the rate of cellulose reduction examined it was observed that all the three species were relatively more active under the aerated conditions, *S. bikiniensis* being most active (Table II).

The isolates were tested for their activity at different pH levels of the substratum by growing in Czapek-Dox solution with 1% cellulose. The results (Table III) showed both *S. olivaceus* and *S. albus* are most active in the pH range of 8.0–9.0, their activity being increased 3 to 4 times than in the acid range.

TABLE I  
Cellulose reduction by *Streptomyces* spp.  
in 23 days

<i>Streptomyces</i> sp.	% reduction		
	Prosopis fruit coat	Filter-paper	Pure cellulose
<i>S. bikiniensis</i>	.. 10.0	9.0	19.7
<i>S. olivaceus</i>	.. 25.0	13.0	28.0
<i>S. albus</i>	.. 15.0	5.0	8.7

TABLE II  
The rate of decomposition of cellulose by the three species of *Streptomyces* under static and aerated conditions

Incubation in days	Static			Aerated		
	<i>S. bikiniensis</i>	<i>S. olivaceus</i>	<i>S. albus</i>	<i>S. bikiniensis</i>	<i>S. olivaceus</i>	<i>S. albus</i>
11	12.3	11.0	3.3	18.0	20.0	13.3
15	21.3	16.0	4.2	22.0	26.0	14.7
19	19.7	18.7	9.3	32.0	29.0	17.3
23	19.7	28.0	8.7	35.3	34.0	21.3
27	18.0	26.7	8.7	33.3	32.0	19.0

TABLE III  
Cellulose reduction by *Streptomyces* spp. under different pH levels of the substratum

<i>Streptomyces</i> sp.	% reduction of cellulose					
	pH of the medium					
	4.0	5.0	6.0	7.0	8.0	9.0
<i>S. bikiniensis</i>	.. 4.0	5.3	16.3	19.7	12.7	7.3
<i>S. olivaceus</i>	.. 4.3	6.7	14.7	18.6	36.0	46.0
<i>S. albus</i>	.. 3.0	5.3	5.7	9.3	44.0	41.3

When 10-day-old preparations of the filtrates from static and aerated cultures of the *Streptomyces* spp. were tested for enzyme activity on potato discs and filter-paper discs, only slight maceration of the potato discs was

noted after 24 hours. The culture filtrates were also tested for the presence of cellulolytic enzymes following the procedure given by Levinson *et al.*<sup>6</sup> The filtrates of all the three isolates from aerated cultures gave white spots (Fig. 1) and the Rf values ranged from 0.38-4.5. These spots might indicate the presence of

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June 13, 1962.

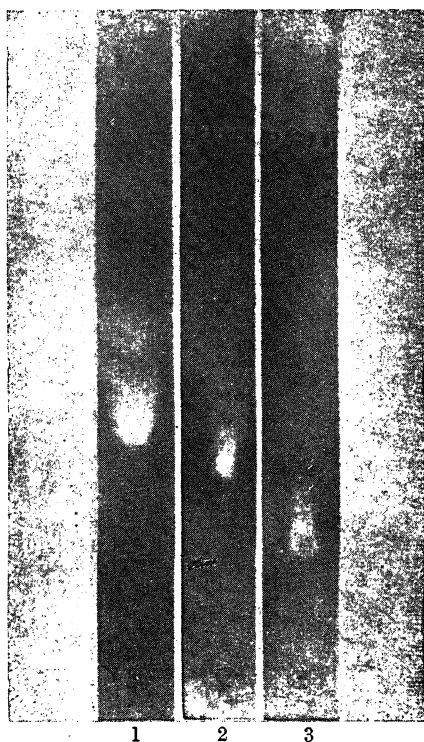


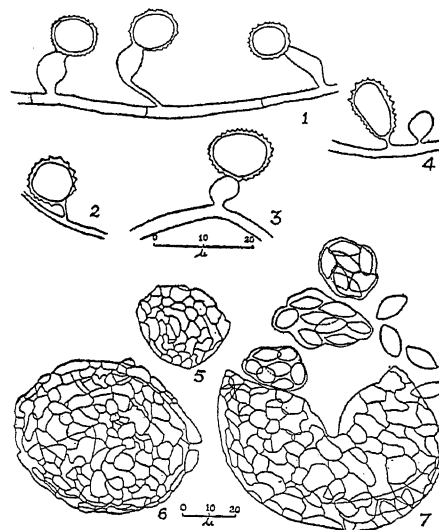
FIG. 1. Chromatographic separation of culture filtrates of *Streptomyces* spp. grown under aerated conditions, developed with 9:1 of 75% isopropyl alcohol and 10 ml. of glacial acetic acid and differentiated with a spray mixture of benzidine 0.5 g. glacial acetic acid 20 ml. and 95% ethanol 80 ml. (1) *S. bikiniensis*, (2) *S. olivaceus*, and (3) *S. albus*.

cellobiose, the first step in the breakdown of cellulose.<sup>7,8</sup> The filtrates from static cultures gave violet and light-white spots in the cases of *S. bikiniensis* and *S. olivaceus* and light-yellow, violet and light-white spots in the case of *S. albus*. The Rf values of the light white and violet spots in the three cases indicate cellulase and cellobiase, respectively and the third spot from *S. albus* might be due to another cellulolytic enzyme.<sup>9</sup> Further comparative studies with pure cellobiose and cellobiase are required to confirm these results.

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### THIELAVIA SEPEDONIUM EMMONS FROM INDIA

DURING the course of isolations of soil fungi from various places a number of Ascomycetes have been isolated which hitherto have not been reported from India. This report deals with an isolate from a soil sample taken from three inches below the surface of an agriculture field in Allahabad, pH 8.2, moisture content 8.2%.



FIGS. 1-7. *Thielavia sepedonium* Emmons. Figs. 1-4. Conidiophores and conidia. Figs. 5-6. Young cleistothecia. Fig. 7. Mature cleistothecium with asci and ascospores.

The conidial stage of the fungus belonged to the form genus *Sepedonium* and the perfect stage to that of *Thielavia*. A culture of the isolate has been deposited in the culture collection of the Botany Department as As-50. The description of the present strain is given below.

Colony on PDA and Czapek's agar sulphur yellow (Ridgway, Pl. V) when young, later olive-buff (Ridgway, Pl. XI), reverse primuline-yellow (Ridgway, Pl. XVI). Conidiophores arising as short branches from the mycelium, variable in length, often swollen below the conidium; conidia single acrogenous, globose to obovate, smooth-walled when young, echinulate on maturity, variable in size, generally  $6-9\mu$  in diameter (Figs. 1-4).

Cleistothecia globose, brown to brownish-black in colour,  $33.9-113\mu$  in diameter, mostly  $56-90\mu$ ; asci globose to oval,  $17.5-25.5\mu$  in diameter, eight-spored, ascospores hyaline when young, brown in colour on maturity, ellipsoidal in shape, smooth-walled,  $12.5-17.5\mu$  by  $7.5-10\mu$  (Figs. 5-7).

Grateful thanks are due to Dr. R. F. Cain for helping us in the identification of the isolate.

Botany Department, B. S. MEHROTRA.  
University of Allahabad, BRIJ RANI MEHROTRA.  
Allahabad, February 12, 1962.

**TRICHOGLOSSUM HIRSUTUM (PERS.  
EX FR.) BOURD. VAR. LONGISPORUM  
(TAI) E. B. MAINS FROM ASSAM  
WITH A NOTE ON THE INDIAN  
GEOGLOSSACEAE**

ON several occasions, a *Trichoglossum* was observed growing on the soil between tea bushes in a neighbouring tea estate. The following is a brief description of a composite local collection assigned to *T. hirsutum* var. *longisporum* which apparently has not been reported from India.

Ascocarps in two of the collections were gregarious and in one scattered, dirty-brown when young, becoming black with maturity, typically clavate, very often spatulate, up to 12 cm. long, fertile part compressed, up to 2.5 cm. long and 8 mm. wide with a rough surface due to the presence of numerous setae. Stipes slender, terete, straight or sinuous, 2-4 mm. in diam., rather stout at the base, hirsute from setae; asci clavate,  $200-280\mu$  by  $18-24\mu$ , ascospores, octosporous, fusoid-clavate, narrowing from each end from above the middle, measuring (120-) 130-185 (-200) by  $5-8\mu$ , mostly 15-septate, often variable up to 20 septa. Paraphyses dilute-brown, cylindric, septate,

rather enlarged at the tip, and straight or curved or circinate. Setae abundant, dark, acuminate, measuring  $300\mu$ , with  $50-100\mu$  of the terminal part projecting above the hymenium making the surface hirsute.

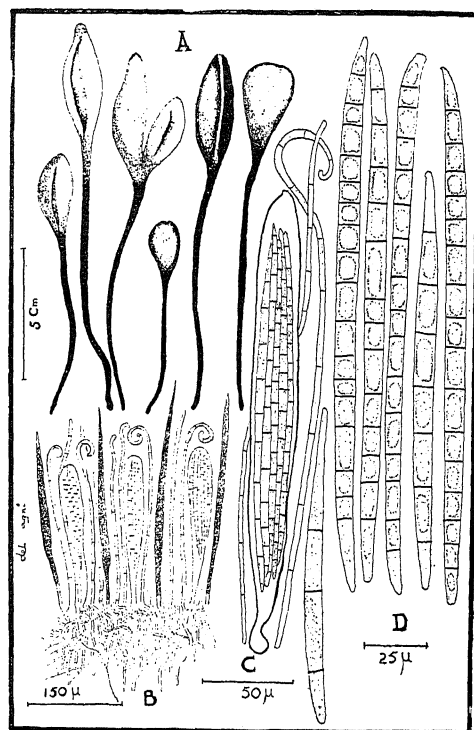


FIG. 1. *Trichoglossum hirsutum* (Pers. ex Fr.) Bourd. var. *longisporum* (Tai) E. B. Mains. A—Ascocarps. B—A section through the hymenium showing asci, setae and paraphyses. C—Ascus and paraphyses. D—Ascospores.

The measurements of asci of the form occurring locally are in close agreement with those given by Tai<sup>1</sup> for *Trichoglossum longisporum* described from Chichushan, Yunnan, China. The ascospores are larger than either the Chinese or Californian collections.<sup>2</sup>

The following species of Geoglossaceae were reported from India:

1. *Geoglossum glabrum* Pers. ex Fr. in *Syst. Myc.*, 1, 488, 1821; Berkeley, in *Decades of Fungi*, Decas, 1-62, No. 472, 1844-56; reported by Hooker from Yeumtong, as *Geoglossum ophioglossoides* (L.) Sacc.
2. *G. alveolatum* (Rehm) Durand in *Ann. mycol. Berl.*, 6, 432, 1908; = *Leptoglossum alveolatum* Rehm in *Ann. mycol. Berl.*, 2, 32, 1905; collected by Butler on soil from Simla and reported as *G. alveolatum* Durand (= *Mitrula alveolata* Durand).

3. *Trichoglossum hirsutum* (Pers. ex Fr.), Bourd. Bull. Soc. mycol. Fr., 1, 110, 1885; = *Geoglossum hirsutum* Pers. ex Fr. in Bull. Soc. mycol. Fr., 25, 131, 1909; reported as *Geoglossum hirsutum* Pers. by C. G. Lloyd<sup>3</sup> from a collection sent him by Wm. Gollan from India. The species is reported to be a very slender form with short setæ.
4. *T. velutipes* (Peck) Durand in Ann. mycol. Berl., 6, 434, 1908; = *Geoglossum hirsutum* var. *americanum* Cooke, Mycographia, 1, 3, 1875; *G. americanum* (Cooke) Sacc., Syll. fung., 8, 46, 1889; as *Geoglossum velutipes* Peck in Rep. N.Y. State Museum, 28, 65, 1876; reported from an oak forest, Muree, Rawalpindi.<sup>4,5</sup>

We are grateful to the Director, Tocklai Experimental Station, for permission to publish this note.

Tocklai Expt. Station, V. AGNIHOTHRUDU.  
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Cinnamara, Assam.  
April 7, 1962.

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## ROOTS WITH AERENCHYMA

A FEW very well preserved roots of an aquatic plant, probably of a marshy one, have been found in some of the rocks of the Deccan Intertrappean beds of India. They are collected from the well-known fossil locality of Mohgaon-Kalan in the Chhindwara District of the Madhya Pradesh, India.

The roots are thin and thick. The thinner ones (Fig. 1) have generally the stele preserved at least partially, whereas the older ones are generally without that. Outside the central stele there are successive concentric rings of aerenchyma developed. The air chambers form a beautiful almost symmetrical pattern and are smaller nearer the stele and larger away from it. They are all bound by cells which are radially elongated into long arms or shanks and are tangentially prolonged into short arms thus separating the cells from each other to produce the large intercellular spaces or the air cavities. In the thicker roots this jacket of the aerenchyma surrounding the centrally lost stele is broken off from the outer cortical ground tissue and the piliferous layer of the epidermis.

This ground tissue is made up of thin-walled parenchymatous cells loosely arranged, keeping



FIG. 1. A thin root in t.s. with aerenchyma,  $\times 22$ .

large irregular intercellular spaces in between. The central stele which is small and poorly developed is bound by an endodermis and a pericycle inside. The exarch xylem is present in a few large metaxylem vessels arranged in a single ring with small protoxylem elements one against each metaxylem one. Phloem is not distinct. The small pith consists of a few thin-walled parenchymatous cells with intercellular spaces.

The nature of the aerenchyma in these roots is very characteristic. At a glance at least it gives an impression of that which is found in the breathing roots of a marshy plant like *Jussiaea*. But the structure in detail seems to be different and further investigation is necessary for its exact identification.

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Bombay-1, July 7, 1962.

## THE ORIGIN OF THE JAMMU MINT

Menthol-producing mints belong to the species *Mentha arvensis* which are very polymorphic genetically and morphologically. Varieties from  $2n=12$  to  $2n=72$  have been reported from Europe (Darlington and Wylie, 1955). These are of no value for menthol production. In India, a variety known as *M. arvensis* var. *javanica* ( $2n=72$ ) is found in Kashmir. The oil content of this variety is also low and only traces of menthol occur in the leaves (Chopra et al., 1946). For this reason it has been rejected as a menthol-producing mint.

The "Japanese mint" *Mentha arvensis* var. *piperascens* with  $2n=96$  chromosomes has 3% oil content of which 70% is menthol. It is

supposed to be a hybrid between the two varieties Man-yo and Ban-Bi grown in Japan and is highly sterile. The Japanese mint was introduced from Japan by the Regional Research Laboratory, Jammu, through the courtesy of UNESCO in 1952 (Handa *et al.*, 1954). It is being extensively cultivated in Jammu and Kashmir at present and the acreage under its cultivation today is increasing as more and more states are taking to the cultivation of this mint.

Suckers of the Japanese mint were treated with colchicine in the Cytogenetics Department of the Regional Research Laboratory in 1960 and a "tetraploid" form with  $2n=192$  was obtained. This new clone was more robust (Fig. 1) and yielded about 4% of oil. Chro-



FIG. 1

mosome doubling also resulted in making the partially sterile Japanese mint into a fertile one. Over 200 seedlings were grown from seeds obtained from this plant in 1961. Of these, 140 seedlings were analysed for oil percentage and 4 of these "tetraploid" seedlings were found to contain more oil than the "tetraploid" parent. One seedling, which had over 5% of oil content on moisture-free basis, was selected as the "Jammu Mint". It is being propagated vegetatively and its performance is being studied under field conditions for large-scale cultivation.

Regional Research, E. K. JANAKI AMMAL.\*  
Laboratory, Assam. Officer on Special Duty  
And

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## CUTICULAR STRIATIONS IN *CESTRUM*

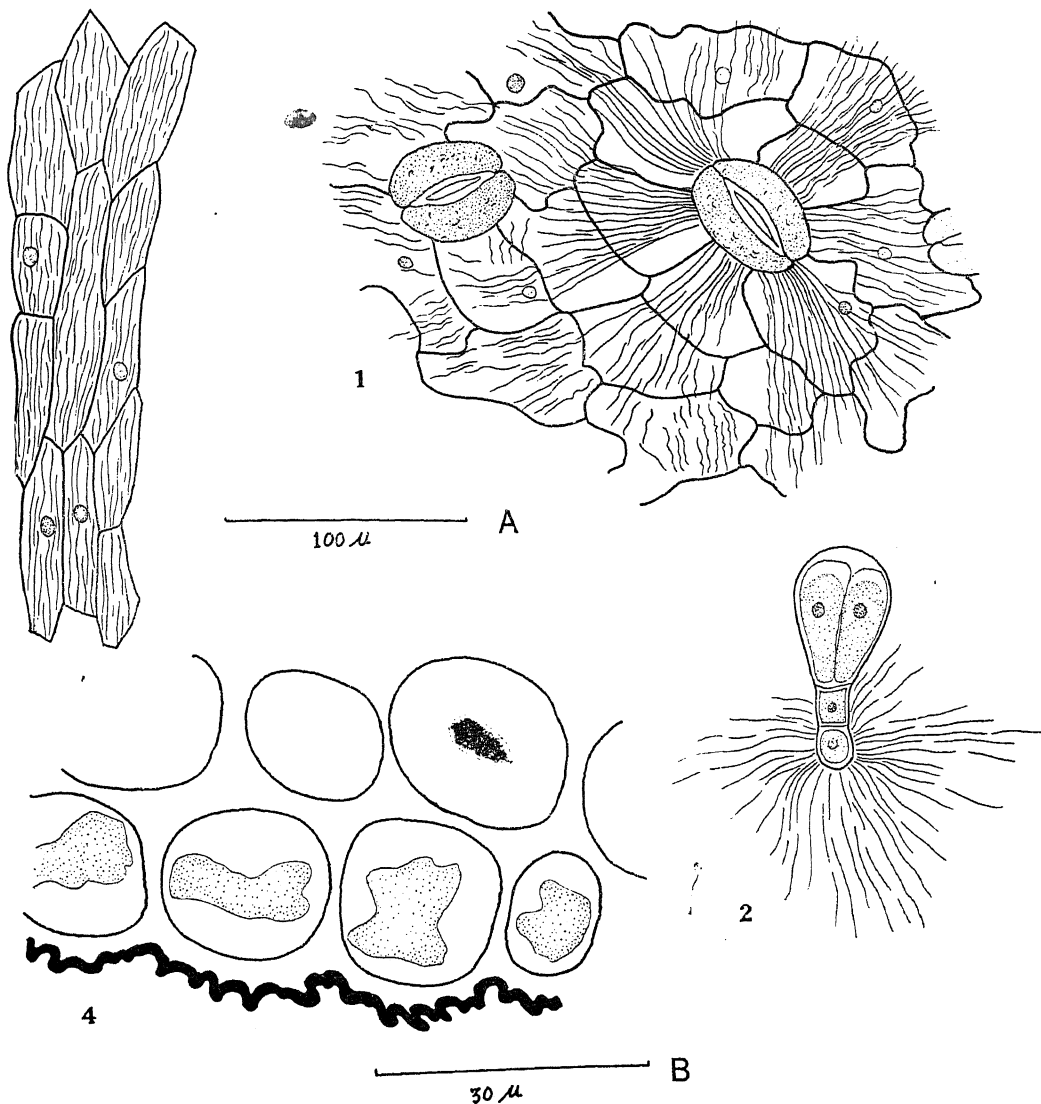
ONE of the interesting features of epidermal studies in Solanaceæ is that cuticular striations occur in certain species of *Cestrum*, while they are conspicuously absent in other species of the genus.

Thomas and Bancroft (1913) found closely lying striations in *Stangeria*. They pointed out that the occurrence of striations was a distinguishing feature of *Stangeria* as it was not found in any other cycad. Rao (1939) reported the presence of cutin striations similar to those of *Stangeria* in some members of the Magnoliales. Hluchovsky and Vladimir (1959) studied striations of leaf surfaces with regard to the guard cells of the stomata in 21 species from 18 families. Sinclair and Dunn (1961), who developed a technique for studying plant cuticles, have shown distinct striations in *Bougainvillea glabra*.

In the present study four species of *Cestrum*, namely, *C. nocturnum*, *C. diurnum*, *C. parqui* and *C. purpurascens* were investigated. These plants were growing in our garden in different beds of a shrubbery under almost identical environmental conditions. Lower and upper epidermal peelings of leaves, fresh as well as fixed in F.A.A. for 48 hours, were stained in 1% aqueous safranin and mounted in 30% glycerine. Some epidermal peelings were also examined without using the cover glass. This was done to rule out the possible appearance of folds or striations due to the weight of the cover glass or due to any other mechanical reason. Transverse sections and durofix impressions of leaves were also prepared and examined. Durofix impressions were mounted in a drop of water and examined under a cover glass.

The striations, which were cuticular in nature, were refractive, broken or continuous lines best focussed differently from the epidermal cells. They radiated from the outer faces of the guard cells, mostly arising all around the guard cells (Fig. 1), but sometimes from the two sides of the guard cells only. The glandular trichomes that were present on the epidermis also acted as focii and the striations also radiated from their bases (Fig. 2).

The striations traversed over the epidermal cells adjoining the guard cells, as well as some observed were confined to the regions of mid-



FIGS. 1-4. *Cestrum diurnum*; Fig. 1. Showing cuticular striations radiating from stomata and traversing over the lower epidermal cells. Fig. 2. The same radiating from the stalk of a glandular trichome of the lower epidermis. Fig. 3. Striations on the midrib region of the upper epidermis. Fig. 4. Showing serrated cuticle in a T.S. of the leaf. Scale A: For Figs. 1-3. Scale B: For Fig. 4.

other epidermal cells following them. Sometimes striations of one stoma traversed a considerable distance and joined the striations of another stoma but they never overlapped.

The striations were usually present on the lower epidermis of leaf only. On the upper

rib (Fig. 3) and other prominent veins. An important observation regarding these striations was that while they were most abundant in *C. diurnum* and *C. parqui*, they were less so in *C. purpurascens* and insignificant or absent in *C. nocturnum*. In the latter species

they were conspicuously absent in intercostal regions but when present, they were confined to the midrib region and less markedly to minor veins. In a cross-section of the leaf of *C. diurnum*, cuticle appeared serrated (Fig. 4) in the regions where striations had formed.

Developmental studies were pursued in some detail in *C. diurnum*. In a young developing leaf (measuring about  $2.7 \times 1$  cm.) striations could be seen for the first time on its median region but not on the basal part of the lamina. Relationship between the development of a stoma and the manifestation of striations was also studied in this species. It was noticed that the stomata acted as foci for the development of striations and that the latter were visible only when the guard cells of stomata had differentiated. In no case were striations found associated with a dividing stomatal mother cell or with a stoma which had not yet developed a normal pore. Similarly the striations could be seen around a glandular trichome only when the latter had differentiated.

One thing that is clear from this study is that the striations are present in intercostal regions of *C. diurnum*, *C. parqui* and *C. purpurascens* but not in *C. nocturnum*. Again the intensity of striations varies in the first three species. These striations seem to have no direct or indirect bearing on any ecological factor. As has been stated above, all the species were growing under identical environmental conditions. Moreover, herbarium specimens of these species collected from different parts of India and abroad were also studied to see whether variation in striations could be found. This study clearly brings out that different climatic and edaphic factors do not affect their development and form.

The author is grateful to Prof. K. N. Kaul, Director, National Botanic Gardens, Lucknow, for his encouragement in this work.

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National Botanic Gardens,  
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May 30, 1962.

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## A SIMPLE METHOD OF GERMINATING SCLEROTIA OF *CLAVICEPS MICRO- CEPHALA* (WALLER) TUL.

IN the course of his studies on the development and cytology of *Claviceps microcephala* (Waller) Tul. inciting the "ergot" disease of *bajri*, the author had occasion to carry out tests in the germination of the sclerotia of this fungus with a view to secure stages of the fertile heads for fixation and subsequent microtome sectioning. The method described here is a modification of the one described earlier by Thirumalachar<sup>2</sup> and subsequently employed by Shinde and Bhide.<sup>1</sup> It has been found to yield a higher percentage of germination and a larger number of fertile stromatal heads per sclerotium.

Mature sclerotia of the fungus obtained from freshly infected *bajri* plants were dried in the sun for a week, then wrapped in wire gauze and buried in dry soil in an earthen pot placed under the shade of a tree for 25 to 30 days. The sclerotia thus treated were first washed in a dilute solution of potassium permanganate for a few minutes and then in water; then they were placed in a horizontal position partially buried in an upper layer of red soil in a pot the lower layer of which was formed of fine sand. The pot was placed in a tray of water so that the sclerotia could be fed with capillary moisture. The pot was covered with a bell-jar during the nights and exposed to diffused light in daytime. The water in the tray was replaced periodically to maintain constant moisture for the sclerotia in the upper layers.

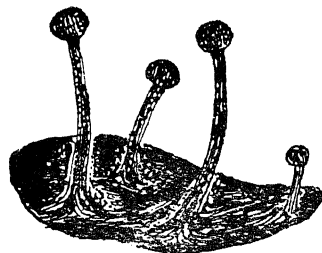


FIG. 1. Germinating sclerotium,  $\times$  about 8.

The sclerotia so treated were found to give out white spots on the exposed surface due to rupture of the cortical layer in 10 to 15 days time. Stromatal heads emerged from each of these white spots in the course of the next week and by 25 to 30 days attained maturity with a short erect stalk, 10–15 mm. in length, bearing a globose, fleshy-coloured, fertile, papillate stroma 1–1.3 mm. in diameter. Each sclerotium gave rise to 4 to 6 stromatal heads,



thus providing ample material for the subsequent developmental and cytological work.

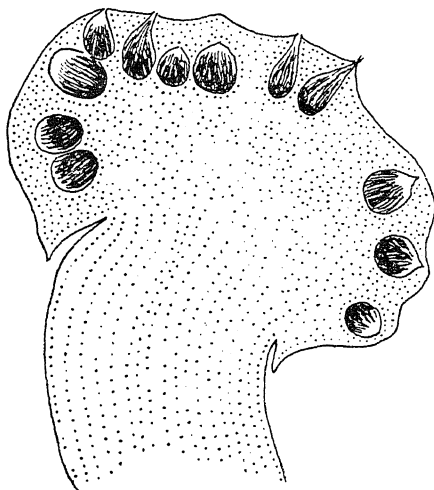


FIG. 2. Section through fertile stroma showing layers of perithecia,  $\times 90$ .

The author is grateful to Prof. M. N. Kamat for his encouragement and guidance and to the Principal for laboratory facilities.

R.P.D. College, U. K. KULKARNI.  
Belgaum, India, March 31, 1962.

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### PROTEIN AND GLUTEN CONTENTS OF SOME IMPROVED INDIAN WHEATS AS INFLUENCED BY VARIETAL AND SEASONAL DIFFERENCES

IN recent years the need for systematic studies on the nutritional and baking quality of Indian wheats has been appreciated. Work on this aspect was taken up at the Indian Agricultural Research Institute first in the Division of Soil Science and Agricultural Chemistry and since 1956 in the Division of Botany. The present paper embodies the results obtained from studies carried out for three years with a number of improved Indian wheats in respect of varietal differences and the effect of season on protein and gluten contents. The importance of these quality characters in governing the baking quality of wheat has been shown by some workers (Greer,<sup>1</sup> Finney and Barmore,<sup>2</sup> Fifield *et al.*<sup>3</sup>). Finney and Barmore<sup>2</sup> and

Fifield *et al.*<sup>3</sup> have shown that the relation between protein (ranging from 8 to 18%) and loaf volume was linear.

Eighteen improved wheats, 17 bred at the Indian Agricultural Research Institute and Punjab C 591 noted for its good grain quality (appearance) were grown during the years 1955-56 to 1958-59 under normal conditions of manuring and irrigation (20 to 25 lb. of N per acre in the form of ammonium sulphate and 2 to 3 irrigations respectively) in the multiplication plot of the Botany Division.

Protein (nitrogen  $\times 5.7$ ) was determined according to the micro-Kjeldahl method and gluten was estimated by the kneading method as described in A.O.A.C.<sup>4</sup> and the data are presented in Table I. It is seen that the percentage of protein and gluten ranged from 10.90 to 13.23 and 9.49 to 12.72 respectively, the varietal differences being highly significant. The protein and gluten contents are generally parallel.

TABLE I

*Protein and Gluten Values of the VR wheat varieties (Averaged over 3 years) (Percentage values on oven dry basis)*

Variety	Protein	Gluten
N.P. 710	13.21	12.72
N.P. 718	13.23	11.92
N.P. 761	11.64	10.51
N.P. 770	12.43	11.93
N.P. 792	10.90	9.49
N.P. 797	11.05	11.22
N.P. 798	11.95	11.48
N.P. 799	11.50	10.44
N.P. 809	12.14	9.58
N.P. 822	12.86	10.15
N.P. 823	12.87	11.30
N.P. 824	12.00	10.66
N.P. 825	11.66	11.23
N.P. 826	11.12	11.21
N.P. 827	12.31	10.90
N.P. 828	12.22	10.86
N.P. 830	11.99	11.12
C. 591	11.58	11.45
S.E. <sub>m</sub>	$\pm 0.403^*$	$\pm 0.406^*$
C.D. at 5%	1.16	1.17

Note: —\*Indicates significant varietal differences at 1% level.

The average values of protein and gluten in 18 varieties compared for the three years also show significant differences due to season but these differences are however small compared to varietal differences. Best results for protein and gluten contents were obtained in 1958-59 as compared to the two previous years.

The authors are thankful to Dr. A. B. Joshi, for his interest in this study and also to Dr. M. S. Swaminathan for his encouragement.

Division of Botany, A. AUSTIN.  
Indian Agri. Research DALJIT SINGH.  
Institute, KUMARI VIMAL JHAMB.  
New Delhi-12, March 6, 1962.

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### CONTROL OF MANGO MALFORMATION IN GUJERAT

SEVERAL workers have described malformation of inflorescences and shoots of mango (*Mangifera indica* L.). Narasimhan<sup>1,2</sup> showed that the disease was incited by Eriophyid mites which invade the meristematic tissue, and bring about proliferation of the host cells resulting in development of leafy shoots in place of normal florets. Unpublished work of Narasimhan<sup>3</sup> has also shown that starting from an infected shoot and disinfecting the mites by systemic insecticides, it is possible to obtain a completely healthy plant.

At the Institute of Agriculture, Anand, Gujerat State, the disease in the last few years had increased in alarming proportions. Investigations were started on a large scale to find out remedial measures on the basis of the observations made by Narasimhan. Experiments\* were laid out in the mango orchard of the Institute with Rajapuri varieties, where the trees of 20 to 30 ft. height showed severe disease symptoms in the last 5 years. The following treatments were carried out.†

During July, soon after the crop was harvested, the diseased inflorescences and shoots were excised one foot below the base and the trees were subjected to the following insecticidal treatments:

- (1) Spraying with 0.1% Folidol, after removing diseased inflorescences.
- (2) Spraying with 0.1% Ekatin, after removal of diseased inflorescences.
- (3) No spraying.

In the sprayed plots, the insecticidal treatment was carried out at intervals of 3 weeks beginning from the last week of August till the first week of December (that is from the end of harvest season to the next flowering period). The number of diseased inflorescences and shoots that were excised were recorded and these are given in Table I.

In the beginning of the experiment (before treatment was started) there were about 1,100 diseased inflorescences and malformed shoots per tree. The disease was building up in virulence with the result reduction in yield was considerable and hardly 10% of the normal yields of fruits were being obtained. On some of the trees, there were no fruits, all the florets developing into witches broom-like structures. The results also indicate the enormous success achieved in controlling one of the major diseases of mango in the country. The removal of the infected shoots and inflorescences from one foot below the point of the attachment of the inflorescences has brought down the disease to less than 2%. Spraying with either Folidol or Ekatin has given over 99% control. There is no significant advantage in this spraying schedule since simple removal of the shoots has given 98% control and thus practically eradicating the disease within 2 years. It is, therefore, concluded that the regular and planned removal of all infected inflorescences and infected shoots up to one

TABLE I  
Showing disease incidence in relation to removal of malformed inflorescences and shoots

	1959*			1960*			1961*		
	Folidol†	Ekatin†	No spraying† (check)	Folidol	Ekatin	No spraying	Folidol	Ekatin	No spraying
Total for 6 replicates	.. 18726	19953	20266	1460	1484	1601	172	231	338
Average per tree	.. 1040	1108	1126	81	82	88	9	13	19
Percentage of disease reduction	..	..	..	92	93	92	99	99	98

\* Diseased inflorescence and shoots were excised in the month of July.  
previous year; hence the figures under these heads are comparable with check,

† No spraying was done in the

foot below the point of attachment to the host, in the months of July and August, would bring in complete control of the disease within a few years. Further large-scale work on the control of mango malformation with reference to increased fruit yields is under progress.

The authors are grateful to Dr. M. D. Patel, Director, for his keen interest and valuable suggestions at all stages of this work.

Institute of Agriculture, M. V. DESAI.

Anand and K. P. PATEL.

Pimpri, Poona, M. K. PATEL.

April 2, 1962. M. J. THIRUMALACHAR.

\* Randomized block design with six replications was used in this study. Under each treatment there were three trees.

† The orchard was planted in 1941-42 and all the trees were uniform in all respects.

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### A NEW TYPE IN SWEET CORN

IN India, unlike in other countries, only one type of maize, viz., flint, is grown and this is used for different purposes. A large quantity of maize is consumed as green cobs in India. For this sweet corn is most suited. It was, however, observed that sweet corn, when grown under Indian conditions, is dwarf, tillers and bears a number of small cobs. Thus we cannot get a good marketable crop of sweet corn from the present varieties. Flint corn as is grown for green consumption is starchy in taste though a good yielder.

It has been reported that sweet corn when crossed with starchy corn gives a  $F_1$  which is starchy and in  $F_2$ , it segregates to 3 starchy to 1 sweet.<sup>1</sup> Due to this simple mode of inheritance, the backcrossing method of breeding is taken to be most suited to transfer the sweet character to flint corn.<sup>2</sup> This method consists of crossing the flint-sweet cross to its flint parent followed by alternate selfing and backcrossing till the desired quality of the material is obtained. Work was started on the above basis, using a sweet corn variety, viz., Maize Dulce from South America and flint variety,

Amarillo-de-Cuba. This sweet corn variety did not grow well under Indian conditions and it tillered too much bearing cobs 3-4" long with 8-10 kernel rows. The variety, Amarillo-de-Cuba, grows well under Indian conditions and bears 1 or 2 cobs of 7-8" long with 14-16 kernel rows. In the first year Maize Dulce was crossed with Amarillo-de-Cuba and then mass-sibbed next year. The flint kernels were rejected and the remaining material was again mass-sibbed. This resulted in semi-sweet cobs of 5-7" long with 10-12 kernel rows. It has a flint plant type and grows without any tillering and bears 1-2 cobs per plant. The grain is sugary in appearance at the top and sides while some soft starch is seen in the centre. Such type is expected to fulfil our present requirement of sweet corn for green consumption.

The case mentioned here has not been reported earlier. However, Mangelsdorf<sup>3</sup> found in a self-pollinated field of the variety, *Surcropper*, a new type of sugary corn. This new type of sugary corn was starchy in appearance in lower half of the seed while in the present case soft starch was found in the centre of the grain. He has advocated that another gene  $Su^{am}$ , an allel of  $Su$ , is involved which made its appearance probably by mutation. Similar amylaceous sugary and pseudo-starchy types have been reported by Cameron.<sup>4</sup> All these cases appear to have taken place as mutations from normal field corn as did the sweet corn.<sup>5</sup> However, the present case does not entertain the possibility of mutation but more probably a gene interaction as it appeared in a cross of sweet and flint. Further studies are being taken up to study this aspect of this new type. Possibilities are also being studied of the commercial utilization of this type.

Division of Botany,  
Ind. Agri. Res. Inst.,  
New Delhi, May 11, 1962.

S. M. VAIDYA.  
BHAG SINGH.

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## REVIEWS

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**Methods of Celestial Mechanics.** By Dirk Brouwer and Gerald M. Clemence. (Academic Press, New York and London), 1961. Pp. 593. Price \$ 15.50.

The book under review consists of seventeen chapters with the following titles: Elliptic Motion, Expansions in Elliptic Motion, Gravitational Attraction between Bodies of Finite Dimensions, Calculus of Finite Differences, Numerical Integration of Orbits, Aberration, Comparison of Observation and Theory, The Method of Least Squares, The Differential Correction of Orbits, General Integrals: Equilibrium Solutions, Variation of Arbitrary Constants, Lunar Theory, Perturbations of the Co-ordinates, Hansen's Method, The Disturbing Function, Secular Perturbations, Canonical Variables.

The first nine chapters deal in the usual manner with the fundamentals of classical celestial mechanics leading to the numerical computation of orbits. The remaining chapters deal with more recent work and contain much of the material that still exists in the original research papers. The treatment of Delaunay transformation and the motion of artificial satellite is novel and masterly.

The book has been written by two outstanding workers in the field. This fact is reflected in the clear, lucid and logical presentation of this rather difficult subject. If one ignores the briefness of the treatment of the numerical analysis, for which a number of good books is available, the book under review is an excellent contribution to the subject and every serious student or worker in the field will be benefited by its study.

P. L. BHATNAGAR.

**Analysis of Deformation, Vol. 4. — Waves and Vibrations.** By K. Swainger. (Chapman & Hall, Ltd., London), 1959, Pp. 370. Price 70 sh.

This book is the fourth of a five-volume treatise by the author on the continuum approach to deformation. The author presented an original theory of finite deformation in Vol. 1. In the second volume, the applications of the above theory were discussed. The third in the series dealt with Fluidity. The present volume follows in presentation and originality the first three volumes.

The formulation of the author's theory on deformation presented in the first volume is applied in this volume to the propagation of stress through, and on the surface of substances possessing different physical properties like elasticity, plasticity, fluidity and combinations of these effects. The book contains ten chapters and seven appendices. A selected list of references is given at the end. After introducing the fundamental concepts and equations for stress, strain, strain-velocity relationships, etc., in the first chapter, the author treats classical mathematical theories to analyse continua in the second chapter. The next seven chapters deal in detail several problems and their solutions regarding waves through fluids, plastic solids and visco-elastic solids and on elastic solids, fluids and visco-elastic solids. In chapter ten, entitled 'Geophysics', are treated topics on possible causes and origin of volcanoes and earthquakes and on the formation of mountains.

The seven appendices contain mathematical information on vector analysis, wave equations and their solutions, transcendental functions, potential theory, harmonic analysis and Lagrange's equations of motion. These are included to help the reader in following the book easily. Throughout the book, vector and dyadic notations are used and in spite of the several appendices, the complicated and unfamiliar symbolism makes the book difficult to study. But this will not come in the way of the usefulness of the book for all those interested in continuum mechanics.

K. T. S.

**A Course of Mathematics for Engineers and Scientists.** By Brian H. Chirgwin and Charles Plumpton. (Pergamon Press, Oxford, London), 1961. Vol. I: Pp. vi + 326. Price 25 sh.; Vol. II: Pp. vi + 382. Price 30 sh.

The books under review are the first two of a projected seven volume work aiming to cover the mathematics for science and engineering courses at British and Commonwealth Universities. Recognizing that the scientist engineer requires *answers* and wishes to employ mathematics to actual problems, the authors include all the basic material in the analytical processes of the calculus, provide enough exercises for gaining manipulative skill and introduce

problems illustrating the use of the analytical techniques in different fields like geometry and mechanics.

The first volume gives the techniques of differentiation and integration of functions of one variable, geometrical applications in two dimensions and has also a chapter on complex numbers. The six chapters of the second volume deal with the integration of ordinary differential equations, solutions of systems of linear algebraic equations using determinants, vector algebra, analytical solid geometry, partial differentiation and multiple integrals. Rigorous proofs have been avoided, but every basic result is fully clothed with a precise mention of the underlying assumptions. A particularly praiseworthy feature of the volumes is the inclusion of a large number of well-arranged and well-graded exercises which often supplement the contents. There is more coverage of matter in the two volumes than meets the reader's eye in a casual glance.

The presentation has a pleasing style, marked for the clarity and conciseness of statements. The present volumes are to be heartily welcomed by all who have concern with instruction in mathematics to first degree courses in science/engineering/technology. One should eagerly look forward for the further volumes of the proposed project.

S. K. L.

**Introduction to Thermodynamics of Irreversible Processes.** By I. Prigogine. (2nd Edition), (John Wiley and Sons, Inc., Interscience Division, 440, Park Avenue South, New York 16, N.Y.), 1962. Pp. xi + 119. Price \$ 5.00.

The laws of classical thermodynamics and their application to physico-chemical processes on a macroscopic scale, are essentially based on concepts of "reversible processes" and "true equilibrium states". However, it is increasingly recognized now that true thermodynamic equilibrium is only attained in exceptional conditions.

Radioactive tracer techniques have shown that nucleic acids contained in living cells continuously exchange matter with their surroundings. Again, on a larger scale, the steady flow of energy originating from the sun and the stars prevents the atmosphere of the earth or stars from reaching a state of thermodynamic equilibrium.

These examples show that there exist a large number of phenomena in biology, meteorology, and astrophysics which are essentially irreversible processes.

The first edition of this book which appeared in 1955 was a timely publication which gave an outline of the thermodynamics of irreversible processes, and introduced the reader to the latest developments in this field. The popularity of the book has demanded a reprint. The only change in the second edition are (i) the addition of a section to Chapter V dealing with "continuous systems", (ii) Non-linear Problems which was included in the first edition as an appendix, appears in the present edition as Chapter VII.

**Retardation of Evaporation by Monolayers—Transport Processes.** Edited by V. K. La Mer. (Academic Press, New York, London; India: Asia Publishing House, Bombay-1), 1962. Pp. xx + 277. Price \$ 10.00.

The problem of conserving water in lakes and reservoirs by suppressing the rate of evaporation is of great practical importance, especially in the tropical and arid zone countries.

Large cities are faced with what has come to be a perennial problem, namely, the supply of water, adequate in amount and safe in quality, to their constantly growing populations. Many of the advanced cities, side by side with their plans for increasing the reservoir capacity of storage water, have shown an awareness for using scientific methods for preventing loss of the stored water by evaporation.

The idea that the rate of evaporation of water could be suppressed by applying a film of an oily substance is a very old one, but the cost of applying a film thick enough to be effective on a large body of water precluded serious consideration for a long time. The discovery that some substances spread spontaneously on water to produce a film only one molecule thick, i.e., a monomolecular layer or monolayer, furnished a new impetus to the subject. Early theoretical work on the study of monomolecular layers was largely due to Langmuir and Rideal.

Two long chain alcohols which have received considerable attention in studies of reduction of evaporation from reservoir surfaces are hexadecanol, abbreviated by the symbol C (16) OH, and octadecanol, C (18) OH.

There are various problems connected with the use of chemical surface layers for suppression of evaporation. The transport of respiratory and toxic gases through monolayers is a matter of great importance for the maintenance of aquatic life, both plant and animal. Again, bacterial activity in the monolayer films used

may affect the efficiency of suppression of evaporation.

The volume under review contains 18 papers presented at the symposium held by the American Chemical Society in New York, September 15, 1960. They touch on various aspects of the physics and chemistry of monolayers with special reference to their use in suppression and retardation of evaporation leading to water conservation on a large scale.

The papers in the first half of the volume deal with theoretical aspects of the subject, while the later papers are practical in nature and describe the results achieved in the field by the use of different methods.

There is no doubt that the book will be of interest not only to scientists working in this discipline but also to administrators and engineers who have to do with water resources and water supply.

A. S. G.

**Solid State Physics (Vol. XI)—Advances in Research and Applications.** Edited by F. Seitz and D. Turnbull. (Academic Press, New York and London; India: Asia Publishing House, Bombay-1), 1960. Pp. xvi + 438. Price \$ 12.50.

Among the new branches of physical research that have come to the fore within the last two decades, physics of the solid state seems to be the most profitable line of research in that the results obtained here are commensurate with the efforts put in. That this is so is apparent not only from the contents of the volumes in this series but also from the rapidity with which these volumes are being issued. Nuclear physics is a keen competitor in the field, but then the centres of activity are not so numerous and so widely distributed as in the case of solid state research. One reason for the lively activity in solid state physics is that it is immediately connected with almost every branch of physics, e.g., high pressure, low temperature, conductivity super- and semi-, spectroscopy, NMR and EPR, neutron diffraction, etc.

The present volume contains five articles reviewing the latest developments in the fields concerned. They are (1) Semiconducting Properties of Gray Tin by G. A. Busch and R. Kern, (2) Physics at High Pressure by C. A. Swenson, (3) The Effects of Elastic Deformation on the Electrical Conductivity of Semiconductors by R. W. Keyes, (4) Imperfection Ionization Energies in CdS-type Materials by R. H. Bube, and (5) Cyclotron resonance by B. Lax and J. G. Mavroides.

The major article in this volume is the one on Cyclotron Resonance which occupies nearly a third of the book. The basic idea in the phenomenon, namely, the principle of the cyclotron, is well known. An electron in a dc magnetic field traces out a helical path with axis along the direction of the magnetic field, and with the cyclotron frequency  $\omega_c = eH/mc$ . If an alternating electric field of frequency  $\omega$ , is impressed transverse to H, then in addition to the rotational frequency  $\omega_c$ , the electron (or charged particle) will oscillate simultaneously at the frequency  $\omega$  as well. If further,  $\omega = \omega_c$ , the particle will gain energy resonantly from the alternating electric field, with the results that its orbit will be a spiral of an ever-increasing radius. This will continue till the charged particle collides with a neutral atom.

Though the cyclotron resonance phenomenon has been known for some time and its manifestations in ionized gases have been extensively investigated, it is only recently that its application to solid state physics began, and already dramatic results have been obtained. Now this technique has proved to be a most sophisticated and valuable tool for studying the basic electronic properties of charged carriers in solids. The article gives an up-to-date survey of the progress made so far in this field and also indicates some of its practical applications that may be realized in the future.

The article on Physics at High Pressure describes recent developments in high-pressure techniques, with special reference to applications in the low temperature region, and gives many new experiments in which these improved techniques have been used. The results obtained in the various fields of study are given in detail and discussed.

The change of resistivity of a solid as a result of the introduction of an elastic strain is a well-known phenomenon. It has been recently found that this piezoresistance effect is quite large in many semiconductors. These large effects can be interpreted in terms of parameters of the electronic wave functions of the semiconductor and their study provides a useful tool for the investigation of various features of the electronic structure in semiconductors. The article deals in detail with this aspect of the subject.

Volume XI of Solid State Physics maintains the high standard of the previous volumes in this series. At the end of the present volume there is a cumulative subject index for volumes I to X.

A. S. G.

**Vocabulary of Mechanics** (*in five languages*). (Pergamon Press Ltd., London), 1962. Pp. vii + 190. Price £ 5 or \$ 15.00.

In the *Vocabulary of Mechanics* about 1,000 important and fundamental terms involved in Mechanics are listed in the five languages, English, German, French, Polish and Russian. The plan adopted is to give the term first in English followed by a concise but clear definition of the term, also in English. Then are entered the equivalents of the term respectively in German, French, Polish and Russian.

The vocabulary is divided analytically into two groups, namely, theoretical mechanics and strength of materials. The vocabulary is authoritative in that it conforms to the terminology recommended by competent scientific Boards of Terminology of the countries concerned.

A third of the book is devoted to five separate indexes in the five languages concerned which will facilitate easy references.

This will be a useful reference book for those engaged in mechanics whose work entails German, French, Polish and Russian translations.

**The Action of Insulin on Cells.** By M. E. Krahle. (Academic Press, Publishers, New York and London), 1961. Pp. ix + 202. Price \$ 7.50.

An account of the current investigations on the mechanism of insulin action has been given in the book under review in a clear and concise measure. The book is divided into ten chapters, the first of which is of an introductory nature emphasizing the importance of the studies on the effect of insulin upon carbohydrate, lipid and nitrogen metabolism. The next four chapters deal essentially with the principal insulin responsive tissues such as muscle, adipose tissue and liver. Detailed effects of insulin on these tissues are elegantly described. The sixth chapter is devoted to the effects of insulin on cell permeability. The influence of insulin on the transport of glucose and natural L-amino-acids and on the anabolic events like the formation of glycogen and incorporation of amino-acids into proteins are briefly outlined.

The relation of insulin to the products of the anterior pituitary and adrenal glands form the subject-matter of the seventh chapter. In the eighth, the author deals with the interactions of insulin with substances of biological interest. It is shown, how insulin can counteract the inhibitions of phosphoglucosylase, phosphor-lylase and muscle hexokinase by  $Zn^{++}$ , protamine

and lipoproteins respectively. The possible relation of these interactions to the biological action of insulin has also been considered. The important aspect of any biologically active protein namely, the relation between structure and activity is treated in the next chapter, which also deals with the factors governing the three-dimensional structure of insulin in solution and about the substances interacting with insulin.

There is a concluding chapter in which the author sets down his speculations on insulin action. He has proposed a mechanism which he claims as a general one to include all the known effects of insulin. However, he admits the weakness in his general speculative scheme due to the difficulty in securing experimental data to support the same. A pleasing feature of this concise volume is the provision at the end of each chapter of a brief summary and a list of valuable references for supplementary study. Taken as a whole, the volume should prove of considerable value to research workers in physiology and biochemistry interested in the action of insulin and other hormones.

P. S. SARMA.

**Pharmaceutical Analysis.** Edited by T. Higuchi and E. Brochmann-Hanssen. (Interscience Publishers, New York and London), 1961. Pp. 854. Price \$ 25.50.

Analytical chemists in the pharmaceutical industry, as well as in those chemical industries that produce pharmaceutical raw materials have to be conversant with techniques for accurately determining small amounts of potent drugs in bulk, particularly in the presence of their degradation products and/or interfering drugs and excipients. While general principles of analysis are outlined in many publications, they are not very helpful in developing new methods for specific needs of this rapidly advancing industry.

This volume presents selected methods currently used by some of the leading pharmaceutical firms in America and the rationale behind these techniques.

The scope of the book is confined to essentially organic pharmaceuticals with only short sections devoted to drugs containing heavy metals.

The analytical methods available for the following groups of compounds have been critically discussed. Hydroxybenzoic acids and their derivatives, carbohydrates and glycosides, steroids, sulfonamides and sulfones, derivatives of carbamic acid and urea, amino-acids, alkaloids and other basic nitrogenous compounds, the

antipyretic analgesics, antibiotics and vitamins. The metal containing organic compounds detailed include organo mercurials and organic compounds containing gold, silver, zinc, lead, manganese, magnesium, aluminium and iron.

The relative merits and demerits of the analytical procedures have been evaluated and an effort has been made to present the basic underlying principles of the techniques adopted. The inclusion of the theoretical review of the physical-chemical factors involved in non-aqueous titration is a special feature of the presentation.

M. SIRSI.

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**Science Progress.** (Edward Arnold Publishers Ltd., 41 Maddox Street, London W. 1), Price 15 sh.

The current issue of *Science Progress*, Vol. 50, No. 199, July 1962, contains the following articles: "On the biology of sand-dwelling ciliates" by Dr. Jean Dragesco; "Cerenkov radiation" by R. E. Jennings; "Recent advances in the investigation of meteorites" by M. H. Briggs; and "Some ice electrification processes" by J. Latham. There are the usual items on Recent advances in science, and Book Reviews.

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#### Books Received

**The Wealth of India—Raw Materials** (Vol. VI) L-M. (Council of Scientific and Industrial Research, New Delhi), 1962. Pp. xxx + 483. Price Rs. 40 or 80 sh.

**Fluctuation Relaxation and Resonance in Magnetic Systems.** Edited by D. ter HAAR. (Oliver & Boyd, London W-1), 1962. Pp. viii + 320. Price 63 sh.

**A Laboratory Manual—Ionization Constants of Acids and Bases.** By Adrien Albert, E. P. Serjeant. (Methuen & Co. Ltd., 36 Essex St., Strand, London W.C. 2), 1962. Pp. xii + 179. Price 21 sh.

**Low Temperature Physics** (5th Edition). By L. C. Jackson. (Methuen & Co., London W.C. 2), 1962. Pp. vii + 158. Price 18 sh.

**Laboratory Organization and Administration.** By K. Guy. (Macmillan & Co., London), 1962. Pp. xiv + 386. Price 50 sh.

**Graft Incompatibility Fruit Trees.** By Barbara Merse. (Commonwealth Agricultural Bureaux, Farnham House, Nr. Slough, Bucks), 1962. Pp. vi + 36. Price 7 sh. 6 d.

**An Introduction to Dimensional Method.** By E. W. Jupp. (Cleaver-Hume Press Ltd., London W. 1), 1962. Pp. 89. Price 12 sh. 6 d.

**Science and Civilisation in China** (Vol. IV), No. 1. By Joseph Needham. (Cambridge University Press, London N.W. 1), Pp. xxxiv + 434. Price 84 sh.

**A Text-book of Zoology** (Vol. II), 2nd Edition. By T. J. Parker and W. A. Haswell. (Macmillan & Co. Ltd., London W.C. 2), 1962. Pp. xxiii + 952. Price 70 sh.

**Report of the Rothamsted Experimental Station for 1961.** (Rothamsted Experimental Station, Harpenden, Herts), 1962. Pp. 296.

**Functions of a Complex Variable and Some of Their Applications.** By B. A. Fuchs and V. I. Levin. (Addison-Wesley Pub. Co., Reading, Mass., U.S.A.), Pp. x + 286. Price \$ 7.00.

**Calculus Variations.** By L. E. Elsgolc. (Addison-Wesley Pub. Co., Reading, Mass., U.S.A.), 1962. Pp. 178. Price \$ 4.50.

**The Physical Chemistry of Metallurgical Processes.** By A. K. Biswas and G. Reginald Bashforth. (Chapman & Hall, London W.C. 2), 1962. Pp. xi + 336. Price 50 sh.

**International Review of Cytology** (Vol. 13). Edited by G. H. Bourne and J. F. Danielli. (Academic Press, Inc., New York), 1962. Pp. v + 393. Price \$ 15.00.

**Introduction to Set Theory and Topology.** By K. Kuratowski. (Addison-Wesley Pub. Co., Reading, Mass., U.S.A.), 1962. Pp. 283. Price \$ 6.50.

**Introduction to Calculus.** By K. Kuratowski. (Addison-Wesley Pub. Co., Reading, Mass., U.S.A.), 1962. Pp. 315. Price \$ 5.00.

**Line Telegraphy.** By P. N. Das. (Modern Book Agency, Calcutta-12), Pp. 179. Price Rs. 7.50.

**Curvature and Homology.** By Samuel I. Goldberg. (Academic Press Inc., New York-3), 1962. Pp. xvii + 315. Price \$ 8.50.

**Horizons in Biochemistry—Albert Szent Gyorgyi Dedicatory Volume.** By Aichael Bernard Pullman. (Academic Press, N.Y.), 1962, Pp. xiv + 604. Price \$ 16.00.



## SCIENCE NOTES AND NEWS

### Award of Research Degree

Osmania University has awarded the Ph.D. degree in Zoology to Shrimati Zubeda Khattoon, for her thesis entitled "Studies on the Mechanism of the Physiological Action of Insecticides at Different Temperatures".

### The Institute of Physics and the Physical Society

At the Second Annual General Meeting of the amalgamated Institute of Physics and Physical Society held in London on 10th July 1962, the following were elected to office: *President*: Sir Alan Wilson; *Vice-President*: Professor B. H. Flowers; *Honorary Treasurer*: Dr. J. Taylor; *Honorary Secretary*: Dr. C. G. Wynne. The three new Ordinary Members of the Council elected were: Dr. D. H. Follett, Professor M. H. L. Pryce, and Professor A. M. Taylor.

Professor P. M. S. Blackett, Sir John Cockcroft, Professor W. E. Lamb, Jr. and Professor C. F. Powell were elected Honorary Fellows.

### Investment in Science: British Association's 124th Annual Meeting

The 124th Annual Meeting of the British Association for the Advancement of Science was inaugurated by Sir John Cockcroft on August 29, 1962 in Manchester, when he delivered his Presidential Address on "Investment in Science".

In his speech Sir John Cockcroft gave a broad survey of the developments in science during the past two decades and stressed the need for greater international co-operation in different fields of science. He gave as an example of international co-operation in science the foundation of CERN, the European Council for Nuclear Research. CERN has turned out to be extraordinarily successful, both technically and scientifically, and has restored to Western Europe the possibility of working in the forefront of high-energy nuclear physics. Physicists from Britain, France, Germany, Italy and other European countries now build in their own laboratories extremely expensive and complicated equipment such as liquid-hydrogen-filled bubble chambers, and move them to CERN where they are used by international teams.

Space research was another expensive field of science, and already collaboration between Britain and the United States had enabled

Britain to launch the first British Satellite, using an American Thor rocket as a launcher.

Outlining the great achievements in scientific research in the past couple of decades, Sir John spoke on the fundamental physics of particles with the help of enormous accelerating machines; radio-astronomy which has contributed to a new understanding of the universe; solid-state physics leading to the transistor industry as well as fundamental knowledge of the properties of metals; the use of very low temperatures for immense magnetic fields needing no power; and amplification devices that produce the most powerful beams of light ever known.

In the life sciences, too, there had been great discoveries on the fundamentals of inheritance, leading even to the first step in the artificial production of genes, the units by which inherited qualities are conveyed. The survey also included latest developments in new fibres, antibiotics, insecticides, fuel cells, computers, and oceanography.

### Volcanoes at the Bottom of the Indian Ocean

The Soviet research ship "Vityaz", which is on a scientific research mission, has left for the shores of Australia, having already covered about 2,200 miles on this voyage.

The scientists aboard the vessel have made a number of interesting observations in the ocean. Two underwater volcanoes up to 3,000 metres high were discovered 210 miles to the south of Christmas Island. One of the peaks is at a depth of 2,500 metres, the other is 3,700 metres below the surface of the water and has the clearly outlined hollow of a crater at its top. Several new mountains were discovered in the waters off-shore North-West Australia.

During their six-month work in the Indian Ocean the Oceanologists collected samples of bottom sediments and information on its distribution in different layers of water as well as on the temperature and salinity of water.

The group of ichthyologists, headed by N. V. Parin, collected a large variety of fishes, among which are some belonging to extremely rare species. The 30 cm. long chiasmodon which they caught is particularly interesting, because so far we had only a description of a fish of this species. The chiasmodon was captured alive.

Near the North-Western cape of Australia the scientists measured the currents to the depth of 2,000 m. by means of an anchored buoy. About 420 miles to the North-West of Freemantle they trawled the sea at a depth of 5,200 m. When the trawl was raised a multitude of black balls rolled on to the deck. The diameter of these strange balls was about 12 cm.; they weighed up to one kilogram each. They turned out to be concretions, masses of ferro-manganese ore. The trawl brought in about 220 of these balls, weighing over 130 kilograms.—(U.S.S.R. *Information*.)

#### Miniature Portable Refrigerators: "Frigistor"

An interesting exhibit at the 1962 Farnborough Air Show is a small "Frigistor" thermo-electric cooling module to be manufactured by a new DE LA RUE subsidiary. The principle involved is the well-known Peltier effect. Frigistors employ semi-conductors based on bismuth and tellurium alloyed with antimony and selenium respectively. A cooling element is made up of four, six, eight or twelve couples, each consisting of a positive and a negative semi-conductor block joined by a copper bridge. The cold junctions are normally arranged on one side and the hot junctions on the other, so that in use the cold side of the module can be mounted in contact with the area to be cooled, whilst a heat sink is attached to the hot side.

The most striking quality of the Frigistor is its small size, an 8 couple 30 amp. module being  $1\frac{1}{2} \times 1\frac{1}{2} \times 5/16$ ". In addition it has no moving parts, is silent in operation and requires no servicing. A cubic centimetre of water placed on top of a Frigistor is frozen solid in 2 minutes; if the current is reversed it will melt again in 3 minutes and begin to evaporate at 70° C. after  $3\frac{1}{2}$  minutes.

At present Frigistor thermoelements are mainly used for the removal of up to 150 B.T.U.'s per hour, but work is in progress to develop techniques suitable for domestic air conditioning and refrigeration.—(*Engineering in Britain News*.)

#### High Frequency Ultrasonic Wave Velocity in Solids

In measuring ultrasonic wave velocities in small crystals to determine elastic moduli there arise difficulties regarding diffraction effects and transducer coupling effects. These however, could be minimised leading to a greater degree of accuracy if measurements are extended to rather high frequencies. For small diamond

crystals, for example, (linear dimensions 3 mm.), frequencies as high as 300 Mc. were indicated.

Apart from the problem of making measurements on very small crystals, there may, on some occasions, be the need to obtain basic data at these high frequencies; for example, in studying materials which exhibit velocity dispersion. Since it is probable that relatively high acoustic losses will accompany such dispersion, even here small path lengths may result.

In a paper contributed to the *Journal of the Acoustical Society of America*, H. J. Mc Skimin of the Bell Telephone Laboratories describes apparatus and circuitry for making measurements of velocity to 500 Mc. Gated harmonic generators for providing pulse moderated rf, of accurately known carrier frequency, and circuits for electrical coupling to resonant quartz crystal transducers are discussed. Applications to measurements on small specimens, with illustrative data for cadmium telluride (CdTe) crystal, of dimensions  $l = 0.7$ ,  $b = 0.4$ ,  $t = 0.352$  cm., are given, and the elastic moduli have been evaluated from these measurements.—(*J. Acous. Soc. Amer.*, 1962, 34, 404.)

#### A New CO<sub>2</sub>-Band in Venus

During a detailed examination of Venus spectrograms in the Mount Wilson Observatory plate files, a band of CO<sub>2</sub> with a head at  $\lambda 7158$  has been discovered. This band had been obtained in the laboratory by Herzberg and Herzberg (1953) as a very weak band when the spectra were taken under conditions of high pressure and a very long path-length.

The new Venus band was found on a plate taken on May 17, 1943. On this date the  $\lambda 7820$  band of CO<sub>2</sub> was anomalously strong.—(*Astro-phys. Jour.*, 1962, 135, 651.)

#### Optical Echoes from the Moon

L. D. Smullin and G. Fiocco of the Research Laboratory of Electronics, Massachusetts Institute of Technology, report on the results of successful experiments carried out at Laxington, on May 9, 10 and 11, to obtain optical echoes reflected from the Moon when pulsed optical radiation was focussed on to the surface of the Moon. The experiment in essence was as follows:

A ruby optical maser radiating pulses of approximately 50 joules energy, 0.5-msec. duration, at 6934 Å. was used as the source. The transmitting optical system included a Cassegrainian telescope of 12-in. diameter. The echoes were received on a Cassegrainian telescope of 48-in. diameter, passed through an interference filter

of 7 Å. band-width and were detected with a photomultiplier tube of spectral response type S-20, cooled to liquid nitrogen temperature. The field of view of the receiving telescope was 0.2 milliradians.

The photoelectron count obtained in a 0.5-msec. interval at the expected time-delay was compared with the counts obtained in 0.5-msec. intervals where no echoes would be expected and where the only relevant contributions to the count were those due to noise, that is, to Earthlight and scattered light (photoelectric dark current was negligible). The experiments gave positive results to show that echoes of the pulsed radiation were received reflected back from the Moon.—(*Nature*, 1962, 194, 1267.)

### Metamagnetics

'Metamagnetics' is the name given to that class of substances whose magnetic properties are such that they cannot be classified either as ferromagnets or antiferromagnets. Examples of metamagnetics are  $\text{CoCl}_2$ ,  $\text{MnAu}_2$ ,  $\text{FeCl}_2$ ,  $\text{NiCl}_2$  and  $\text{CrCl}_3$ .

Taking  $\text{FeCl}_2$  as a typical example of this class, measurement of its magnetic susceptibility above 75° K. gives rise to a positive value (48° K.) of the paramagnetic Curie temperature. This shows a ferromagnetic transition. On the other hand susceptibility measurements at lower temperatures show a maximum at about the temperature at which a  $\lambda$ -type anomaly occurs in the specific heat. This suggests an antiferromagnetic transition. Furthermore, the spontaneous magnetization exhibited by a ferromagnet is absent in  $\text{FeCl}_2$ . Also its characteristic magnetization curve at low temperatures precludes its being classified either as a ferromagnet or as an antiferromagnet.

The structure of  $\text{FeCl}_2$  is of the  $\text{CdCl}_2$  type and consists of hexagonal layers of metal atoms. Recent investigations of the ordering by means of neutron diffraction show that the atomic magnetic moments within layers align parallel and that alternate layers are aligned antiparallel, the moments being directed perpendicular to the planes of the layers. Thus each magnetic sublattice of the crystal consists of alternate layers of spins. The ordering suggests that there is ferromagnetic coupling within the layers and antiferromagnetic coupling between layers. Many of the magnetic properties of  $\text{FeCl}_2$  can be explained using this scheme.

The mathematical treatment of the problem consists in dividing the lattice into two sub-

lattices,  $\alpha$  and  $\beta$ , each consisting of alternate layers of metal atoms. Then each atom has six nearest neighbours to which it is coupled ferromagnetically, and which lie in the same layer and thus on the same sublattice. Also each atom will have six next nearest neighbours to which it is coupled antiferromagnetically, and which are situated three in each of the adjacent layers, and this on the opposite sublattice. For complete antiferromagnetic order all the spins on the  $\alpha$  sublattice are + and all those on the  $\beta$  sublattice are —.

In the Bethe-Peierls approximation method we consider a cluster of atoms consisting of a central atom and the twelve neighbours to which it is coupled. First we consider a cluster centred on the  $\alpha$  sublattice, and then the cluster centred on the  $\beta$  sublattice. In calculating the magnetic properties account is taken of a ferromagnetic interaction of strength  $J_r$  between nearest neighbours in a layer, and an antiferromagnetic interaction of strength  $J_A$  between next nearest neighbours in adjacent layers.

In a paper contributed to the *Proceedings of the Physical Society*, B. R. Heap, of the Clarendon Laboratory, Oxford, uses the Bethe-Peierls method to derive the magnetic properties of  $\text{FeCl}_2$  and finds agreement between theory and experiment.—(*Proc. Phys. Soc.*, 1962, 80, 248.)

### Colloidal Nature of Petroleum

An important problem in petroleum research is to find out if particles of colloidal dimensions (10 to 5000 Å) occur in crude oil. A knowledge of the colloidal components in crude oil will be useful not only in the study of the rheology of crude oil but also in such fundamental problems as petroleum recovery and utilization, not to speak of the intriguing problem of the origin of petroleum itself.

Crude oil is an exceedingly complex mixture of hydrocarbons and non-hydrocarbons. The hydrocarbons are composed of large groups of paraffins, naphthalenes and aromatics that range in complexity from the simplest methane molecule to complicated ring systems with numerous alkyl side-chains. While the hydrocarbon chemistry of crude oil is fairly well known, our knowledge of the non-hydrocarbons is far from complete. These are compounds that contain, in addition to carbon and hydrogen, significant amounts of nitrogen, oxygen and sulphur. In recent years considerable data have been obtained on the lower molecular weight sulphur-containing and nitrogen-containing compounds, but much remains to be learned of the asphaltic portion.

This constitutes a substantial portion of  $\bar{x}$  crude oil and plays a major role in controlling the physical properties of the system.

The asphaltic components in petroleum may be conveniently divided into two portions based on their solubility in normal pentane. The soluble portion known as maltenes is usually a viscous liquid (resins and oils). The insoluble portion is known as asphaltenes, and is a black powdery solid which when heated does not soften but decomposes and finally sinters together. Recent investigations have begun to reveal important details of the chemical structure of asphaltenes.

Through the application of electron microscopy, ultracentrifugation and rheological techniques, it has been found that asphaltenes exist in crude oil as particles with dimensions of the order of 40 to 100 Å. Asphaltenes have molecular weights in the range 1000 to 5000, but they have a tendency to aggregate even in good solvents. This tendency is apparently the explanation for the wide variations in the experimental values for the molecular (or particle) weight of asphaltenes, from 30000 to 500000, that have been obtained from a variety of independent methods of investigation. Particles of this size have a profound effect on the rheological behaviour of petroleum, even when present in small concentrations.—(Trans. N.Y. Acad. Sc., 1962, 24, 344.)

#### *Acanthophora spicifera* Found in Hawaii

*Acanthophora spicifera* is a fairly common alga of the Western Pacific Islands, and with one singular exception has not been associated with any land east of the Carolinas or Mariannas north of the Equator.

In the fall of 1952, and again in 1953, specimens were found in Hawaii and called to the attention of Maxwell S. Doty of the Botany Department of the University of Hawaii. No

record exists of the alga in Hawaii prior to that time. Since then, it has become so ubiquitous that it is crowding out some of the native forms of marine algae as it encircles Oahu and spreads to other islands in the chain.

Dr. Doty believes that the alga was brought to Hawaii on a ship's bottom. Writing in *Pacific Science*, the author points out that a heavily fouled barge, the "Yon 146", was towed from Guam to Pearl Harbor in 1950; it could have provided a sufficiently massive inoculation for *A. spicifera* to become established. The concrete-hulled vessel, 200 feet long and 56 feet wide, was placed in a dry dock just 12 km. and 30 km. from the sites where the first two specimens of the alga were recovered.—(The Sciences, N.Y. Acad. Sc., March 15, 1962.)

#### International Symposium on Protein Structure and Crystallography

The Department of Physics, University of Madras, is arranging to hold an International Symposium on Protein Structure and Crystallography in Madras during January 14-18, 1963, which will be presided over by Professor Sir Lawrence Bragg. The Symposium will consist of two parts (a) dealing with the Structure of Proteins and other biological materials and (b) dealing with methods of Crystal Structure Analysis and Crystal Perfection.

The Symposium will be followed by a Winter School under the auspices of the C.S.I.R. and U.G.C. on "Advanced Methods of Crystallography" during January 22-27, 1963. Ten distinguished scientists attending the Symposium will be delivering a total of 30 lectures on various topics connected with crystallography and imperfections in crystals.

Further details about the Symposium and the Winter School can be had from the Secretary, C/o The Department of Physics, University of Madras, Madras-25.

# THE INFRA-RED BEHAVIOUR OF DIAMOND

SIR C. V. RAMAN

**D**IAMOND was recognised and esteemed as a precious stone in India since ancient times. The ready cleavage parallel to the octahedral planes of the crystal which it exhibits was discovered and made use of in shaping the diamond for various purposes. Indeed, flat plates obtained by such cleavage were polished and inserted as such into jewellery with a view to exhibit the characteristic lustre of the gem. Such jewellery having gone out of fashion, it was found possible to acquire material for research in this form, which is obviously the most suitable for precise investigations on the optical properties of diamond. The four largest plates in the collection acquired by the author in the course of years are roughly circular or oval in shape and have a superficial area of about three square centimetres each. The total number of plates, a hundred in all, is sufficiently great for the collection to be considered truly representative of diamonds of the first quality.

Using polished flat plates of diamond, the following studies are readily carried out: firstly, the determination of the presence or absence of birefringence in the diamond, revealed by the restoration of light appearing when the plate is held between crossed polaroids and viewed against an extended source of light; secondly, the ultra-violet transparency or opacity of the diamond in the wavelength range between 3000 Å and 4000 Å which is readily determined by placing the diamond on a plate of fluorescent glass so as to cover it in part and observing the effect of passage of the ultra-violet rays through the diamond; thirdly, the manifestation of visible luminescence by the diamond itself under irradiation in the same range of wavelength; fourthly, the infra-red absorption spectrum of the diamond which is studied with an infra-red recording spectrophotometer in the wavelength range between  $2\mu$  and  $12\mu$ .

In a memoir<sup>1</sup> which has been recently published, the results of the investigation by the methods indicated above of the author's entire collection of plates of diamond have been set out, illustrated by numerous photographs and spectrophotometer records, and discussed in

detail. A very clear picture emerges from the study of the close relationship which exists between all the four properties referred to and the dependence of all of them on the crystal structure of diamond. In particular, the infra-red records made with the four largest plates in the collection and with the spectrophotometer running at its slowest speed have revealed much significant detail. In consequence, the conclusions which have emerged from the investigation have a firmly established factual basis.

Nothing in the nature of a full review of the contents of the memoir will be attempted in the present article. Its object is to present a few considerations of a general nature regarding the origin of the infra-red activity exhibited by diamond and its relation to the structure of that crystal. The perusal of the article may be useful as a preliminary to a detailed study of the memoir cited above.

## THE FREE VIBRATIONS OF THE STRUCTURE

The structure of diamond is well known, but may be usefully recalled here. It may be described as the result of the interpenetration of two rhombohedral lattices, the points of which are occupied by atoms of carbon. The two lattices are so located with respect to each other that each carbon atom in one lattice is surrounded by four atoms in the other lattice in a tetrahedral configuration. In the octahedral and cubic layers of the structure, the atoms belonging to the two lattices appear alternately. The octahedral layers are unequally spaced, being alternately closer together and further apart. On the other hand, the cubic layers of the structure are all equally spaced.

The absorption of infra-red radiation by a crystal is an effect arising from the interaction of the electromagnetic field in the radiation with the structural units composing the crystal. As a first step towards an understanding of this effect, it is necessary to consider the nature of the free or spontaneous vibrations of these structural units. We may deduce their modes and frequencies by the methods of classical mechanics. For this purpose, the atomic nuclei may be regarded as simple mass particles and the electronic clouds surrounding them as massless springs which hold the structure together: The relevant theory is fully set out

<sup>1</sup> Raman, C. V., "The Infra-Red Absorption by Diamond and Its Significance," *Memoirs of the Raman Research Institute*, No. 129. Also, *Proceedings of the Indian Academy of Sciences*, 1962, 55, 1-61.

in the memoir cited above and it is sufficient here to state the results to which it leads.

equivalent atoms appearing in adjacent layers may be either in the same phase or in the

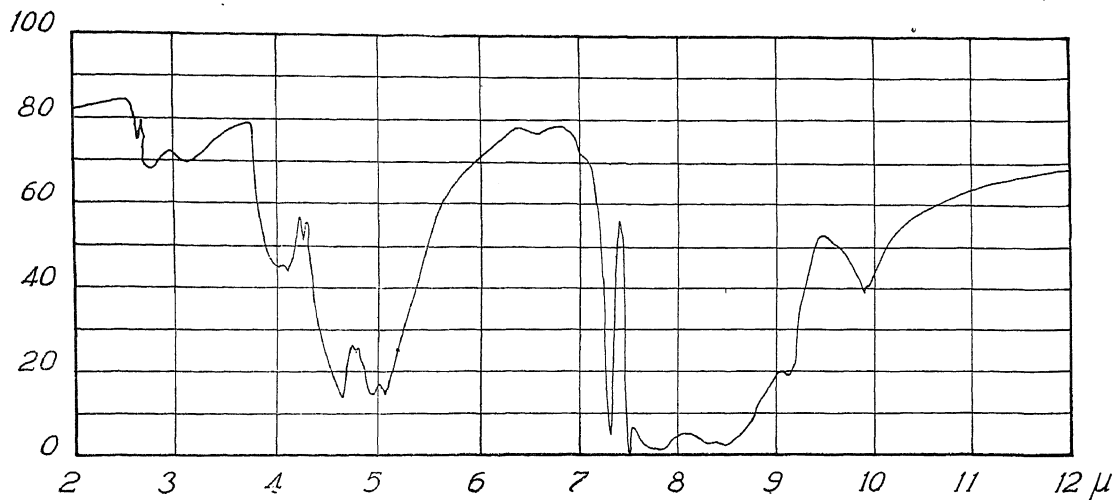


FIG. 1. Infra-Red Absorption Spectrum of Diamond (Plate thickness 1.44 mm.).

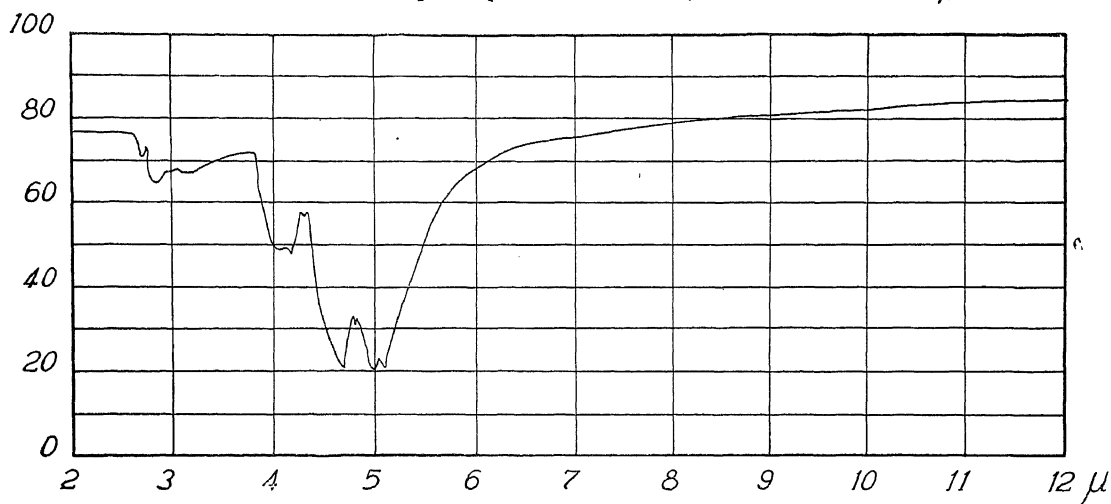


FIG. 2. Infra-Red Absorption Spectrum of Diamond (Plate thickness 1.06 mm.).

It emerges that the vibrational mode of highest frequency is one in which the two non-equivalent sets of carbon atoms oscillate against each other in opposite phases. Eight other modes of free vibration are also possible. They may be described very simply in terms of the crystal structure. Four of the modes are oscillations of the cubic layers, while the other four modes are oscillations of the octahedral layers in the structure. The movements may be either normal or tangential to those layers and they alternate in phase as we pass from any one layer to the next equivalent layer in the structure. Since the movements of the non-

opposite phases, we have eight modes in all, besides the principal mode of highest frequency already mentioned.

#### THE ORIGIN OF INFRA-RED ACTIVITY

We next proceed to consider the relation between the free vibrations of the crystal and the effects arising from the passage of infra-red radiation through it. The electric field in the incident radiation acts both on the positively charged nuclei and on the negatively charged electrons. But in all the modes of vibration with which we are concerned, there are as many positively charged nuclei moving in one

phase as there are others moving in the opposite phase and with an equal amplitude of vibration. It follows as a consequence that the displacements of positive charge when totalled up cancel out in all the modes under consideration. Hence, the free vibrations of the structure cannot be excited by the forces exerted by the field on the atomic nuclei. Necessarily, therefore, the movements of the atomic nuclei can have no effect on the radiation passing through the crystal. We conclude that the infra-red activity of the crystal arises solely by reason of the forces exerted by the field on the negatively charged electrons and of the resulting movements; such activity is only possible when the displacements of negative charge produced do not cancel out when summed up over each structural unit.

Since the electrons are held in position by their interactions with each other and with the positively charged nuclei, the displacements of negative charge would necessarily disturb the nuclei from their positions of equilibrium. But the nuclear movements thus arising would not contribute to the infra-red activity. Thus, while in the free vibrations of the structure, the massive positively charged nuclei play the leading role and the electrons a subsidiary one, the situation is reversed in respect of the infra-red activity, the electrons here playing the leading role and the nuclei a subsidiary one. In other words, the spectrum of free vibrations and the spectrum of infra-red absorption are essentially different in their nature and origin. Being both properties of the same structure, we may expect to find some resemblances, but nothing in the nature of an identity or complete correspondence is to be expected.

From what has been stated, it follows that in seeking for an explanation of the infra-red activity of diamond, we have to fix our attention on the electronic charge-clouds in the crystal. It is the distribution of the negative electric charges in its undisturbed state as well as when it is modified by the nuclear movements which would determine the appearance or non-appearance of infra-red absorption and its actual magnitude when observed.

#### THE ELECTRONIC CONFIGURATION

Diamond exhibits in its structure a perfect demonstration of the validity of the concept of the tetrahedral carbon atom. For, the four valence bonds joining each carbon atom with its four nearest neighbours are parallel to the four tetrahedral axes of the crystal. There is no reason to believe or assume that the two sets

of carbon atoms thus linked together are in any way different from each other. Indeed, we may take it for granted that both sets of atomic nuclei have associated with them equal distributions of negative charge. But it would not necessarily follow from this that the electronic configuration in the crystal would exhibit centres of symmetry located at the midpoints between every pair of adjacent atoms in the structure. For, we have to consider not only the static distribution of negative charge but also the movements of the electrons linking the carbon atoms and circling around the four tetrahedral axes of the structure. These movements would be such that the structure as a whole is diamagnetic. The tetrahedral setting of the axes of the structure ensures that whatever be the sense of the electronic movements about these axes, the magnetic moments arising therefrom would cancel out completely, provided the sense of the movements is the same for all four axes. This leaves the sense of the movements of the individual electrons in each pair forming a valence bond, an open question. If the senses of the movements of the two electrons are opposed to each other, then both in the static and dynamic pictures, there would be a centre of symmetry located at the midpoint between the nuclei under consideration. But, if on the other hand, the senses of the movements of the two electrons around the tetrahedral axes are the same, then there could be no centre of symmetry located at that point.

Thus, considerations of a very general nature indicate the possibility of the structure of diamond either possessing or not possessing the maximum symmetry of the cubic system. In other words, diamonds may belong either to the octahedral or to the tetrahedral class of that system. This is indeed the case as is evident from studies on the naturally occurring crystal forms of diamond, as also from studies of the various physical properties of diamond which are influenced by the symmetry of the electronic configuration within the crystal. In particular, spectroscopic theory indicates that studies of the infra-red behaviour of diamond should yield clear and unquestionable evidence bearing on this issue.

#### THE EFFECTS OF CRYSTAL SYMMETRY

If the midpoint between every pair of adjoining carbon atoms in the crystal is a centre of symmetry, it follows that the principal mode of oscillation of the structure in which the two sets of atoms move with equal amplitudes but in opposite phases would not give rise to any

displacement of electric charge. Hence, the frequency of this mode would fail to manifest itself in the absorption of infra-red radiation. The frequencies of the remaining eight modes of vibration would also fail to appear, but for a wholly different reason. In each of these eight modes, the phase of the movement is reversed as between any one layer of atoms and the next equivalent layer. The displacement of charge resulting from the relative displacement of two adjacent layers of atoms in the crystal would be cancelled out by the displacement in the opposite direction due to the next pair of equivalent layers. It should be remarked however that such cancellation would be complete only in the first approximation. If the finiteness of the amplitudes of oscillation in the structural units is taken into account, there would be a difference left over, as a consequence of which each of the eight modes would be active in the second approximation. Hence, they would manifest themselves in absorption with doubled frequencies.

The strength of the second-order effect referred to above would necessarily be different for each of the eight different modes of vibration, since it would depend on the movement of charge resulting from the approach or recession of the adjacent layers of atoms in the crystal. As has already been remarked, the spacing of these layers is different in the cubic and octahedral planes and in the latter case alternates between two very different values. Since the movements of the layers may be either normal or tangential to the layers, very large differences may be expected between the magnitudes of the second-order infra-red activities of the eight modes. Thus, the situation may be summed up by the statement that the centrosymmetric diamonds would fail to exhibit any infra-red absorption of the first order, but that a second-order absorption would be manifested by them.

If, on the other hand, the electronic configuration in the crystal is such that the midpoints between every pair of adjacent carbon atoms are not centres of symmetry, an oscillation of the two sets of atoms in opposite phases with respect to each other would give rise to a periodic displacement of the negative electric charges with the same frequency. The principal mode of free vibration of the structure having the highest frequency would accordingly manifest itself as a first-order absorption frequency. Thus, the presence of a first-order absorption would reveal that the crystal lacks centres of symmetry in its inner structure and hence should

be assigned to the tetrahedral class of the cubic system instead of the octahedral or highest class of symmetry of that system. Since such lack of centro-symmetry is a consequence of the dynamic characters of the electronic configuration and not of any lack of symmetry in the static distribution of electric charge, the resulting first-order absorption cannot be expected to manifest the extraordinary strength with which it appears in such cases as, for example, the alkali halides. Indeed, it should not surprise us to find that the first and second-order absorption spectra of the diamonds exhibiting both of them are of comparable strength, instead of the first-order absorption being enormously more intense than the second-order as in the case of the alkali halides.

A few further remarks are here necessary. For the same reason that the first-order and second-order infra-red absorptions are of comparable strengths with the diamonds exhibiting both of them, we should expect to find that the characters of their second-order absorption spectra do not sensibly differ from those observed with the diamonds which exhibit only the second-order absorption. For, the origin of the second-order absorption would in both cases be the same, *viz.*, the finiteness of the amplitudes of oscillation and the resulting incomplete cancellation of the displacements of electric charge of opposite sign in the alternate layers of the structure. Such cancellation would however continue to be operative in the first approximation even in the case of diamonds lacking centres of symmetry. The excitation of the principal mode of vibration having the highest frequency may, however, be expected to result also in the excitation of the modes of lower frequency as an accompaniment, the strength of such excitation being determined by the difference between their frequencies and that of the mode of highest frequency. In other words, in the first-order absorption spectrum of the diamonds exhibiting it, not alone the mode of highest frequency but also the modes of lower frequencies may be expected to appear, their strength falling off rapidly as the frequency deviates more and more from the highest.

#### CONCLUDING REMARKS

Figures 1 and 2 above are reproductions of a selection from amongst the numerous spectrophotometer records illustrating the memoir cited above. They represent two typical cases and serve to show that the resemblances and differences between the absorption spectra of diamonds having the lower and the higher



symmetries as observed are fully in accord with those indicated by the considerations set forth above. Attention may also be drawn to the extreme sharpness of the peaks of absorption as recorded by the spectrophotometer in both figures. Such sharpness is a natural consequence of the free vibrations of the structure of diamond exhibiting a set of nine precisely defined monochromatic frequencies. It should also be remarked that the frequencies determined spectroscopically as well as their observed

activities are in satisfactory accord with those deduced theoretically. Further on the basis of the spectroscopically determined frequencies alone and without using any other data, the heat capacity of diamond can be evaluated theoretically over the entire range from the lowest to the highest temperatures; the results obtained are in highly satisfactory agreement with the thermally determined values. The reader will find these and many other matters set out and discussed in the memoir cited.

## LOCATION OF WELL-MARKED JET-STREAMS IN THE ABSENCE OF HIGH LEVEL WIND DATA

N. C. RAI SIRCAR AND D. N. SIKDAR

*Meteorological Office, Bombay Airport, Bombay-29*

WITH the advent of the jet age, the forecasting responsibility of the Main Meteorological Office at Bombay, the western gate of India, has increased considerably. In this study, it has been examined whether it is possible to locate the jet-stream with its core near the 200 mb. level and fluctuating about 30° N over the Middle East with the help of temperature data when the wind observations are meagre or absent. Some instances of very strong and relatively very weak upper wind fields over the middle-east countries have been examined with reference to the horizontal temperature distribution at 300 mb. level over the same area and the results discussed in some detail.

For the issue of forecasts for operations of Jet aircraft, 300, 200 and 100 mb. constant pressure charts are prepared as a routine. It is seen from the day-to-day analysis of these charts that the isotherms are generally nearly parallel to the latitude lines, and that the temperature gradient is steep at 300 mb. level over the middle-east region, weak at 200 mb. level and reversed at 100 mb. level, suggesting that the jet core is generally located near the 200 mb. level. A qualitative analysis has been made of the temperature data at 300 mb. level, to see if the high or low temperature gradient at this level is, in practice, invariably associated with strong or weak wind fields respectively above this level and whether this information could be utilised for the purpose of practical forecasting of jet-streams in the absence of high level wind data.

The present study is based on the available data from: (1) Aden (lat. 12° 50' N, long. 45° 02' E); (2) Aswan (lat. 23° 58' N, long. 32° 47' E);

(3) Bahrein (lat. 26° 16' N, long. 50° 37' E); (4) Cairo (lat. 29° 52' N, long. 31° 20' E); (5) Basra (lat. 30° 34' N, long. 47° 47' E); (6) Mersa Matruh (lat. 31° 20' N, long. 27° 13' E); (7) Lod (lat. 32° 00' N, long. 34° 54' E); (8) Beirut (lat. 33° 49' N, long. 35° 29' E) and (9) Nicosia (lat. 35° 09' N, long. 33° 17' E).

The cases of very strong wind fields and those of relatively very weak wind fields during the winter months December 1960 to March 1961 were selected for this study. During the winter months, instances of wind speed of 80 to 100 knots between 300 and 200 mb. levels are quite common. The occasions when at least one station reported 125 knots or more and also the occasions when none of the stations recorded winds stronger than 75 knots were sorted out from the daily working charts for the period under study, with a view to examine the distinctive features of the temperature distributions at 300 mb. level under these two types of extreme conditions. The number of each category of such occasions was only five. The horizontal temperature gradient at 300 mb. level over the area in question on the above dates were obtained by plotting 300 mb. temperature *versus* latitude. The available maximum wind in the area is also plotted in the diagrams with its height. In some cases, this height is the maximum height reached by the balloon and as such may not necessarily represent the height of the jet-stream. The jet-stream, when present, was at this height or above. The evening data have been examined as some of the stations under study do not make morning ascents.

Figure 1 represents the temperature curves for the occasions when the maximum wind

speed over the region was 75 knots or less. It will be seen that the slope of the temperature curves was small and generally gradual, suggesting that no well-marked front was present over the area. As such, the slope of the pressure surfaces was small and consequently the wind field, too, was weak.

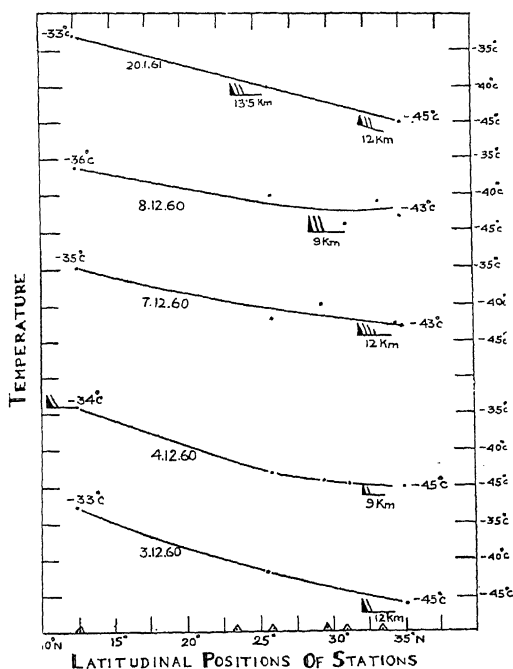


FIG. 1. S-N Temperature distribution at 300 mb. level (Weak wind fields).

The temperature curves for the occasions when well-marked jet-streams were present are shown in Fig. 2. It will be seen from these curves that except on 28-1-1961, a sharp temperature gradient was present at 300 mb. level in the vicinity of the jet-stream on all the above occasions. Of all the jet-streams examined in this note, the one present on 27-1-1961 was the strongest. Bahrain reported 130 knots, Beirut 160 knots and Nicosia 150 knots. In fact, two cores were present on this day—one near Bahrain and the other near Beirut. These two cores were separated by relatively weak winds, Lod (lat. 32°N) an intermediate station having reported only 95 knots. The core of both the jet-streams were located near the 200 mb. level. There were, in fact, sharp temperature changes below the above level both near Bahrain and Beirut. The strong jet-stream near Beirut continued next day (28-1-1961) also but the strong temperature gradient at 300 mb. level did not persist. The high level wind data of Beirut

were not received on this day, but it is seen that the available maximum wind over the area was 150 knots at 9 km. reported from Nicosia. Winds at higher levels over this station were not available. If it is assumed that the jet core was at about 9 km. on this day, one cannot expect high temperature gradient at 300 mb. level which should be a level of equalisation of temperature. High temperature gradient should, in fact, exist in the lower levels. The temperature curve for 400 mb. level for the same day is shown in dotted lines. This curve shows that there was actually a sharp temperature drop near Beirut and Nicosia. The winds over Bahrain also continued strong on this day. But it is not clear how such winds could exist there without the presence of a high temperature gradient.

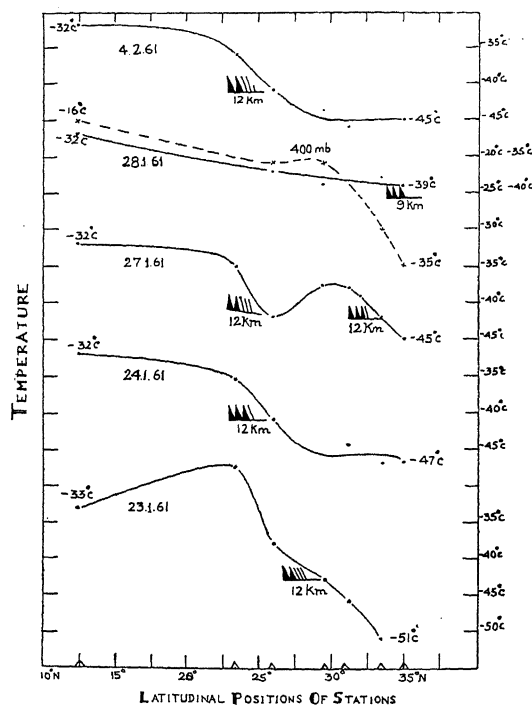


FIG. 2. S-N Temperature distribution at 300 mb. level (Strong wind fields).

It would, thus, appear from the instances examined in this note, that the horizontal temperature gradient at 300 or 400 mb. level generally gives some useful indication about the presence or otherwise of a well-marked jet-stream aloft and its geographical location. In the absence of high level wind data, this method may be of some use to a forecaster in giving information about jet-streams to pilots.

## A CLASSIFICATION OF THE HYPHOMYCETES

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DURING recent years considerable attention has been given to the Hyphomycetes and it is significant that the main aim of some at least of the leading mycologists interested in this group has been to develop a classification which may serve the needs of pure and applied mycologists better than the current system of classification which is due to Saccardo.<sup>1,2</sup> As is well known, Saccardo classified the Hyphomycetes into four families: the Mucedinaceæ, the Dematiaceæ, the Tuberculariaceæ and the Stilbaceæ, the hallmark of the Tuberculariaceæ being production of sporodochia, that of the Stilbaceæ of synnemata and that of the Mucedinaceæ and the Dematiaceæ of simple conidiophores not aggregated into sporodochia or synnemata. The Mucedinaceæ were delimited by Saccardo as the hyaline counterparts of the Dematiaceæ, the hyphæ or spores or both in the latter being dark-coloured. Thus, the primary criteria used for classification by Saccardo were the solitary nature of the conidiophores or their aggregation to form sporodochia or synnemata and also the colour of the hyphæ, conidiophores and conidia. The mode of formation of spores, as far as it was understood, was given secondary importance. Although as early as 1888 Costantin<sup>3</sup> proposed a classification of about one hundred genera of Hyphomycetes in which he gave primary importance to the mode of insertion of the spore on conidiophores and even distinguished a category in which the spores were stated to be enveloped in slime—the “slimy spores” of Mason<sup>4</sup> and their corollary, the Gloiosporæ of Wakefield and Bisby<sup>5</sup>—his classification was eclipsed by that of Saccardo whose *Sylloge Fungorum*, by its very nature, remained better known. Subsequent work by Vuillemin in France and by Mason at the Commonwealth Mycological Institute, Kew, truly laid the foundations for a new classification of this important group. The acceptance of the type method and its strict application in taxonomy requires a proper understanding of all genera of the Hyphomycetes and more especially of the old and classical ones which have been taken for granted and accepted *sensu* Saccardo who, in treating of the various genera, often excluded the type species from them. The impact of Article 48 of the 1961 International Code on the nomenclature of the genera so treated by Saccardo would be such as to release a number of later homonyms. In the elucidation of

generic characters based on types, Mason<sup>4,6,7</sup> made outstanding contributions and, during the past several years, has also inspired much critical work of which special mention may be made of the papers by Hughes.<sup>8,9</sup> Although Hughes contributed considerably to our knowledge of tropical Hyphomycetes represented by numerous African collections which he made and studied, his new approach<sup>8</sup> to classification in which he emphasized the importance of the method of spore formation in taxonomy was illustrated by examples largely of Hyphomycetes commonly found in Europe. There is no doubt that Hughes made a positive approach to a new classification worthy of serious consideration. If there are apparent difficulties in accepting his proposals, these do not stem from his system but reflect our present inadequate knowledge of many generic types which are either imperfectly known or not known at all; but this deficiency applies to Saccardo's system also. It is now generally agreed that the basis on which Saccardo divided the group into families is not sufficiently reliable as a criterion for delimiting families, although these characters would be useful in classification at lower levels.<sup>8,10-12</sup> Hughes has, indeed, clearly set forth the lines on which a new classification may be founded. A classification, like a language, must be used if it were to live and it is therefore worthwhile assessing the usefulness of this classification by using it and putting it to test. Lack of knowledge about precise mode of formation of spores in several genera prevents elaboration of a complete classification, but it would be desirable to apply the new concepts to a classification of the genera which are adequately known.

During the past some years I have collected and studied Hyphomycetes in this country and, during a stay at the Commonwealth Mycological Institute some years ago, have had access (through the very kind courtesy of Dr. S. P. Wiltshire and Mr. E. W. Mason, past Director and Mycologist respectively of the C.M.I.) to type specimens of several Hyphomycetes commonly recorded in Europe. While Hughes<sup>8</sup> recognized eight categories or sections, each with a characteristic method of spore formation, and Tubaki<sup>10</sup> added a ninth category, I believe that several other categories would have to be recognized to properly classify the Indian, or for that matter the tropical Hyphomycetes.

Details of these will be presented elsewhere; the main purpose of this paper is to establish a taxonomic grouping of the Hyphomycetes on the basis of our present knowledge of both temperate as well as tropical forms.

The classification being proposed here is primarily based on the mode of formation of spores. For this purpose, six distinct morphological categories of spores are recognized. They are:

1. the *blastospore*, formed as a blown-out end from any cell on a fertile hypha or, where spores develop in acropetal chains, from the previously formed spore as well;

2. the *gangliospore*, developed by the transformation of the swollen tip of a hypha into a spore: a conidium initial may or may not be delimited;

3. the *phialospore*, abstricted from the tip of a phialide in succession, endogenous or exogenous, sometimes grouped into false heads at the tips of the phialides, sometimes forming basipetal chains. The phialospores are usually thin-walled. The phialide is a unicellular structure which is usually terminal on simple or branched conidiophores and is oval to subcylindrical to flask-shaped or subulate, often with a distinct basal swelling and a narrow distal neck, with or without a terminal collarette;

4. the *porospore*, formed through minute terminal or lateral pores on the wall of the conidiophores: such spores are usually rounded at the base and even in contour except for a basal pore corresponding in position to its point of attachment to the conidiophore;

5. the *arthrospore*, formed as a result of septation and breaking up of simple or branched hyphae;

6. the *meristem-arthrospore*, formed at the tip of a conidiophore which remains meristematic, and differentiated in basipetal succession: such spores may or may not form chains. The conidiophore is sometimes poorly differentiated and its tip imperceptibly merges with the chain of conidial initials which exhibit a gradual maturation towards the distal end of the chain.

A seventh category, the *spiculospore*, may also be recognized and this is formed at the tip of a pointed structure often elongate and so resembling a spike, as in *Hirsutella* and *Akanthomyces*. More work appears necessary, however, before this spore-category can be used for any formal taxonomic grouping. The following six families are recognized here to take in the bulk of the Hyphomycetes hitherto classified in the Mucedinaceae, the Dematiaceae, the Tuberculariaceae, and the Stilbaceae of Saccardo's system:

1. *Torulaceae* Corda emend. (Corda, 1837, *Icon. fung.*, 1 : 12). Hyphomycetæ producentes blastosporas. Genus Typicum: *Torula* Pers. ex Fries, 1832, *Syst. Mycol.*, 3 : 501. (Hyphomycetes producing blastospores. Type genus, *Torula* Pers. ex Fries.)
2. *Bactridiaceae* Corda emend. (Corda, 1837, *Icon. fung.*, 1 : 12). Hyphomycetæ producentes gangliosporas. Genus Typicum: *Bactridium* Kunze ex Fries, 1832, *Syst. Mycol.*, 3 : 433. (Hyphomycetes producing gangliospores. Type genus, *Bactridium* Kunze ex Fries.)
3. *Tuberculariaceae* Ehrenb. emend. (Ehrenberg, 1818, *Sylv. mycol.*, p. 12). Hyphomycetæ producentes phialosporas. Genus Typicum: *Tubercularia* Tode ex Fries, 1832, *Syst. Mycol.*, 3 : 464. (Hyphomycetes producing phialospores. Type genus, *Tubercularia* Tode ex Fries.)
4. *Helminthosporiaceae* Corda emend. (Corda, 1837, *Icon. fung.*, 1 : 12). Hyphomycetæ producentes porosporas. Genus Typicum: *Helminthosporium* Link ex Fries, 1832, *Syst. Mycol.*, 3 : 354. (Hyphomycetes producing porospores. Type genus, *Helminthosporium* Link ex Fries.)
5. *Geotrichaceae* fam. nov. Hyphomycetæ producentes arthrosporas. Genus Typicum: *Geotrichum* Link ex Sacc., 1886, *Sylloge Fungorum*, 4 : 39. (Hyphomycetes producing arthrosporas. Type genus, *Geotrichum* Link ex Sacc.)
6. *Coniosporiaceae* fam. nov. Hyphomycetæ producentes meristem-arthrosporas. Genus Typicum: *Coniosporium* Link ex Fries, 1832, *Syst. Mycol.*, 3 : 256. (Hyphomycetes producing meristem-arthrosporas. Type genus, *Coniosporium* Link ex Fries.)

Since considerable differences can be recognized in the mode of insertion of the different types of spores mentioned here, it will be appropriate to divide these families into subfamilies. Details of the delimitation of these subfamilies and the disposition of the genera of which species are known from this country will be presented elsewhere.

Notwithstanding what has been proposed, some difficulties remain: some fungi are known to produce several "imperfect spore forms" and in such cases there is the possibility of the different "states" of the fungus being placed in diverse genera. Thus, several genera such as *Acremoniella* Sacc., *Humicola* Traaen, *Chlamydomyces* Bainier and *Botryotrichum* Sacc. and March. are based on their gangliospore states, but they are also known to produce phialospores.

In these cases, the choice of a generic name would have to be made arbitrarily since, unfortunately, no ideal solution to this difficulty appears possible at present. Mason has admirably discussed these difficulties and stressed the need to study the fungi in their "hochkultur", a concept which has been conveniently and elegantly used in the classification of *Fusaria* by Appel and Wollenweber and several later workers. There have also been suggestions for developing a classification of the *Hyphomycetes vis-a-vis* their relationship to perfect stages. Indeed, "if we could consistently predict the Perfect genus by an inspection of its conidia, there would be no need for an Imperfect classification at all". As Mason<sup>4</sup> emphasized, "over large tracts of the Fungi Imperfecti, however, we cannot do so, and unless

the Perfect classification becomes improved out of all knowledge, it does not appear probable that we ever shall be able to do so".

I am grateful to the Rev. Fr. Dr. H. Santapau for the Latin diagnoses.

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### ADVANCES IN CANCER RESEARCH\*

IN recent years there has been so much work on cancer research that it is almost impossible for any one to keep pace with the findings of various workers. Comprehensive reviews on the different aspects of oncology are therefore most welcome. This need has been fully met by the series of *Advances in Cancer Research*, the first five volumes of which were ably edited by Dr. J. P. Greenstein and Prof. A. Haddow. For the sixth volume Prof. S. Weinhouse joined Prof. Haddow as co-editor owing to the death of Dr. Greenstein. The sixth volume contains reviews on blood enzymes in cancer, enzymes in hepatocarcinogenesis, cancer chemotherapy by perfusion, radiation chimeras, mouse leukæmia and antagonists of purines, pyrimidines and folic acid. A small chapter on plant tumour problem has also been included.

The topic of blood enzymes in cancer and other diseases has been extensively reviewed by Oscar Bodansky. Studies on serum enzymes have been classified into two types: (1) Tissue specific enzymes and (2) Enzymes involved in metabolism. Any defect in the secretion or excretion of tissue specific enzymes is reflected in the serum which is indicative of the pathological process. For example, the elevated levels of acid phosphatase indicates carcinoma of the prostate and those of serum alkaline phosphatase indicate osteogenic sarcomas of hepatobiliary diseases. The potentialities of serum

enzymes such as 5-nucleotidase and glucose-6-phosphatase indicating hepatobiliary disease and other hepatic disorders have been rightly stressed by the author. The field opens up possibilities of finding out tissue specific enzymes and those indicating hereditary diseases such as cardiovascular disorders which would be revealed by their alterations in the peripheral blood. The second class is that of the metabolically involved enzymes. Since these enzymes are neither tissue nor disease-specific the alterations of these enzymes in the serum have no significance on the induction of the disease. However although the serum enzyme in this class constitutes a mixture of functionally similar enzymes from different tissues, it is possible to distinguish them by using kinetic electrophoretic and immunological procedures. Their alterations in the serum may then possibly indicate a specific disease or a pathological process. This would, however, need further exploration.

The chapter on blood enzymes has been very well written. It gives details about the properties, assays and significance of the various serum enzymes and should prove of immense value to workers in the field.

Among the biochemical investigations in carcinogenesis the problem of hepatocarcinogenesis has been studied quite extensively. This is due to two reasons: (1) The liver is an organ of major metabolic importance and (2) it has afforded appropriate normal tissue for comparison which is very essential for investigations on carcinogenesis. The review on enzymes in hepatocarcinogenesis relates a systematic

\* *Advances in Cancer Research*, Vol. 6. By Alexander Haddow and Sidney Weinhouse. (Academic Press, Inc., New York and London), 1961. Pp. 524. Price \$ 13.00.

exploration of metabolic behaviour of normal and neoplastic liver. Various qualitative and quantitative enzymatic alterations in the metabolic behaviour of hepatoma have been properly emphasized in this review. The absence or depletion of enzymes such as G-6-Pase, responsible for release of glucose and phosphoglucomutase for glucogenesis with a substantial increase in G-6-P dehydrogenase responsible for glucose oxidation *via* HMP pathway and the increased production of lactic acid mark the carbohydrate metabolism of hepatoma as distinguished from normal liver. The increased anabolism and the decreased catabolism of nucleic acids, the dependence of Krebs cycle enzymes on pyridine nucleotides and the decreased fatty acid synthesizing enzymes are some of the other salient features of the hepatoma. However, the author, George Weber, has rightly emphasized the point that an increase or decrease in enzymes may not be indicative of the behaviour of the metabolic pathways in general and a critical evaluation of the other factors is essential to draw valid conclusions.

The review on enzymes in hepatocarcinogenesis is comprehensive as well as lucid. The author has compared different types of hepatomas in their carbohydrate, protein, nucleic acid and fat metabolisms with due consideration to the morphological aspects.

A chapter on cancer chemotherapy by perfusion has been made equally illuminating by Creech and Kremenz. This technique has been recently adopted for increasing effectiveness of toxic chemotherapeutic substances such as nitrogen mustards. The techniques of regional perfusion are based on the concept that various anatomic regions can be isolated from the remainder of the circulation, supplied with a separate extraneous system for pumping and oxygenating blood. This new technique thus permits the use of toxic anticancer agents in amounts far exceeding the permissible safe doses. The chapter deals with detailed surgical descriptions of perfusions relating to lower extremity, upper extremity, pelvis and brain. The dosage, pathological changes and complications are discussed in detail. The authors have stressed the need for careful and proper post-operative management when perfusion techniques are employed. As a review on a recently developed technique, it should prove of considerable help and value to surgeons and clinicians.

The chapters on etiology of mouse leukæmia make very interesting and absorbing reading. Leukæmia in mice could be caused by oestro-

gens, carcinogenic hydrocarbons, ionizing radiations and viruses. In a systematic review Gross has given the stepwise development of the viral origin of mouse leukæmia. Thus, according to Gross, although several factors are necessary for the evolution of the disease, the main responsible agent is a submicroscopic, filterable, thermolabile, self-reproducing and transmissible particle which probably belongs to carcinogenic viruses. Evidence has been cited to suggest the presence of a latent leukæmogenic agent which gets activated subsequent to total body irradiation. Miller in his review on etiology of mouse leukæmia has discussed various other factors influencing susceptibility to leukæmia such as genetic factors, influence of age, nutritional factors, endocrine factors, thymus involvement and many others. The review is marked by a very interesting discussion on the pros and cons of the virus theory in the causation of mouse leukæmia. The lack of evidence for replication, infectiousness and antigenicity are some of the factors against this theory. The author has brought out the problem of thymus involvement, removal of which prevents the development of the disease, and has stressed the need for elucidation of relationship between the leukæmogenic virus and the thymus factor. Both these reviews on etiology of mouse leukæmia contain useful discussions.

The problem of protection against radiation injury deserves to be considered by a larger number of scientists, especially in this atomic age. Reviews such as the one on radiation chimeras by Koller and colleagues serve a useful purpose. The present review deals in detail with damage to hematopoietic system with a radiation dose 400 r to 1,500 r. The methods of identification of the chimeric state and the tissue therapy have been reviewed in a lucid manner. The immunological approach to the problem has been thoroughly discussed. The application of the bone marrow therapy in the treatment of leukæmia in experimental animals and at clinical levels has formed an important part of this review.

The series of volumes on "Advances in Cancer Research" has been serving a very useful purpose. Besides giving detailed reviews on various aspects of oncology the volumes have helped in the critical appraisal of problems and a stimulation of new ideas. Volume 6 is in the tradition of the preceding volumes and should prove of great help to clinicians and researchers alike.

## LETTERS TO THE EDITOR

## HYDROGEN BONDING IN ALCOHOLS

(Electrostatic Interaction)

In the earlier work<sup>1</sup> we have calculated the shift in the stretching frequencies of the hydroxyl group of methanol and ethanol due to hydrogen bonding. In these calculations, we have treated hydrogen bonding as an electrostatic interaction and assumed that the ionic character of a bond diminishes due to intermolecular associations. In this communication, the shift in the OH stretching frequencies of normal and iso-propanols, normal, secondary and tertiary butanols due to hydrogen bonding have been calculated by the same method, by way of extension and strengthening of the earlier results.

The absorption spectra of these alcohols have been recorded with Perkin-Elmer Infra-red Spectrophotometer Model 21 using NaCl optics. The bonded OH stretching absorption bands of these compounds have been recorded by pressing a drop of the liquid of each compound between two plates of NaCl so as to obtain a microfilm of unknown thickness. The scattering losses of radiation are eliminated by using a NaCl plate of equivalent thickness in the reference beam. The free OH stretching absorption bands of these alcohols have been recorded in solutions of CCl<sub>4</sub> with a single cell of calcium fluoride of thickness 0.094 mm. These recorded frequencies are given in Table III. The unbalanced charges on various atoms or groups of atoms of these molecules are shown in Fig. 1 and the values of the unbalanced charges are given in Table I.

TABLE I

Unbalanced charges on different atoms or groups of atoms (in 10<sup>-10</sup> e.s.u.)

Substance	q <sub>1</sub>	q <sub>2</sub>	q <sub>3</sub>	q <sub>4</sub>	q <sub>5</sub>	q <sub>6</sub>	q <sub>7</sub>
<i>n</i> -Propanol	1.60	-1.54	-0.97	0.37	0	0.27	..
<i>iso</i> -Propanol	1.60	-1.59	-1.02	0.37	0.27	..	..
<i>n</i> -Butanol	1.60	-1.77	-1.21	0.37	0	0.27	..
<i>s</i> -Butanol	1.60	-1.72	-1.16	0.37	0.37	0	0.27
<i>t</i> -Butanol	1.60	-1.49	-0.92	0.27	..	..	..

In addition to the bond moments reported earlier,<sup>1,2</sup> we use  $\mu(\text{CH}_2) = 0.4 \text{ D}$  and  $\mu(\text{C}-\text{C}) = 0$ . Table II gives the values of the constant 'a'

TABLE II

Dissociation energies of bonded OH linkages of the alcohols (in 10<sup>-12</sup> ergs/molecule) and 'a' (in 10<sup>8</sup> cm.<sup>-1</sup>)

Substance		D'	a
<i>n</i> -Propanol	..	6.468	2.311
<i>iso</i> -Propanol	..	6.477	2.311
<i>n</i> -Butanol	..	6.525	2.310
<i>s</i> -Butanol	..	6.506	2.310
<i>t</i> -Butanol	..	6.457	2.297

TABLE III

Calculated and observed free and bonded OH stretching frequencies (in cm.<sup>-1</sup>)

Substance		Free OH stretch	Bonded OH stretch		$\Delta \nu$
			Observed	Calculated	
<i>n</i> -Propanol	..	3636	3320	3313	+ 7
<i>iso</i> -Propanol	..	3635	3322	3316	+ 6
<i>n</i> -Butanol	..	3629	3318	3329	-11
<i>s</i> -Butanol	..	3630	3322	3324	- 2
<i>t</i> -Butanol	..	3614	3315	3305	+10

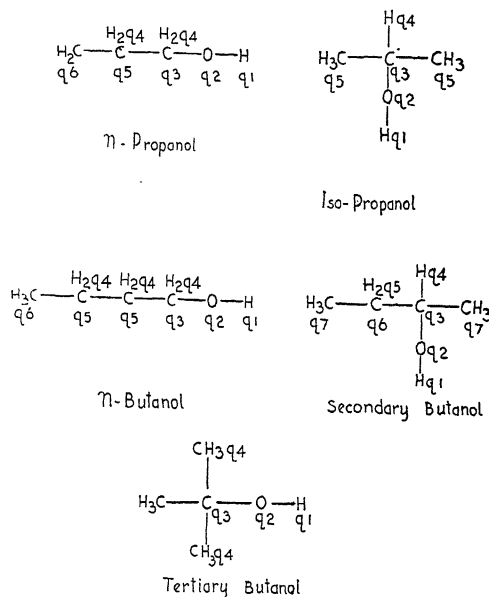


FIG. 1

obtained by using the free hydroxyl frequency of each compound and the dissociation energy D' of the corresponding bonded OH linkages.

$D'$  is obtained as earlier<sup>1</sup> from the expression  $D' = 110.6 - 42F_1/F_2$ .

Using these values of  $D'$  the bonded OH stretching frequency in case of each compound is calculated and these are given in Table III.

It is seen from these observations that the observed bonded OH stretching frequencies agree fairly with the calculated values.

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University College of Science,  
Osmania University,  
Hyderabad-7, August 8, 1962.

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#### A NOTE ON THE FRANCK-CONDON FACTORS OF THE $\alpha$ -SYSTEM OF TiO

ACCURATELY computed values of the Franck-Condon (FC) factors ( $q_v', v''$ ) of TiO are essential in view of its predominant astral aspect, as TiO is a dominating molecule in  $\beta$ -Pegasi according to Davis.<sup>1</sup> It is with this object that the computation of FC-factors of the  $\alpha$ -system of TiO has been made using the Bates' method<sup>2</sup> involving numerical integration, strictly according to the details of procedure given by Tawde and Murthy.<sup>3</sup> The values of  $\alpha_1$  and  $\alpha_2$  used for this computation are as follows:

$$\alpha_1 = 1.798567 \text{ \AA}^{-1}; \quad \alpha_2 = 1.811184 \text{ \AA}^{-1}$$

The molecular constants given by Herzberg<sup>4</sup> have been adopted for the computations. The anharmonic wave functions<sup>2</sup> are calculated at an interval of 0.01 Å for 81 values of  $r$ , ranging from  $r=1.26$  to  $r=2.06$  Å for both the upper and the lower states of the system. The evaluation of FC-factors is made by numerical integration with proper normalising factors. The FC-factors computed by this procedure are 0.394<sub>3</sub> and 0.380<sub>8</sub> for the (0,0) and (0,1) bands of the  $\alpha$ -system of TiO.

It is well known that  $q(0,0)$  obtained from harmonic considerations should be nearly equal to the one obtained by using anharmonic wave functions in the case of (0,0) band, i.e., in the region  $v=0$  for which the potential energy curves in the case of both harmonic and anharmonic oscillator almost coalesce. To have an external check on the above tedious procedure of numerical integration,  $q(0,0)$  is computed by the method of Manneback<sup>5</sup> using simple harmonic wave functions, and is found to be 0.398, which is near to the value obtained by the use of anharmonic wave functions.

Similar values of FC-factors for the TiO  $\alpha$ -system have been reported by Prasad<sup>6</sup> and Ortenberg<sup>7</sup> using an approximate method.<sup>8</sup> The values given by Prasad are 0.394<sub>4</sub> and 0.381<sub>0</sub> and those of Ortenberg are 0.366 and 0.358 for the (0,0) and (0,1) bands respectively. It has been shown<sup>4,3</sup> that the approximate method gives results nearly identical with those from numerical integration at least for bands with low quantum numbers. In the present case of TiO  $\alpha$ -system this should be so even without the perturbation correction as the Morse constants  $\alpha_1$  and  $\alpha_2$  are nearly equal. From our present study we are inclined to place more reliance on the latest results of Prasad, and that the earlier values of Ortenberg are likely to be in error, perhaps due to the use of incorrect values of  $\alpha$ 's.

I am deeply grateful to Professor N. R. Tawde for encouragement and for the help rendered in the preparation of the manuscript. I also express my gratitude to the National Institute of Sciences of India for the award of a Post-doctoral Senior Research Fellowship.

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Dharwar,  
August 21, 1962.

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#### PARA PROTON-FLUORINE SPIN COUPLINGS IN FLUOROBENZENES

In the long-range nuclear spin-spin interactions in organic compounds  $\pi$  electron contributions appear to play an important part. Sufficiently large values of coupling constants due to  $\pi$  electron contribution have been observed via even five chemical bonds or more.<sup>1</sup> It is well known that in any ring system the strength of the coupling through the sigma electrons falls rapidly with the increase of separation of the nuclei in terms of chemical bonds. However, the coupling can still take place through the mobile  $\pi$  electrons even when the separation in terms of chemical bonds is large.



The *para* proton-fluorine couplings in fluorobenzenes have values of the order of a few cycles/second (say up to 3 cs./sec. in some cases) though the two nuclei are separated by as many as five chemical bonds. A study of several substituted fluorobenzenes was, therefore, undertaken to confirm whether the coupling takes place predominantly through the  $\pi$  electrons.

The *para* H-F couplings were determined from the first-order analysis of the fluorine NMR spectra. The spectra were recorded by a Varian High Resolution NMR Spectrometer operating at 56.445 Mc/s. The samples were obtained from commercial sources and the purity was verified from their boiling points.

Table I gives the values of the *para* H-F coupling constants in fluorobenzenes. The

TABLE I  
Para H-F couplings in fluorobenzenes

Substituent S	Hammett Constant <sup>2</sup>		Coupling in <i>meta</i> - substituted compounds (structure I) in c./s.	Coupling in <i>ortho</i> - substituted compounds (structure II) in c./s.
	$\sigma_I$	$\sigma_R$		
-NH <sub>2</sub> ..	0.10	-0.76	3.2	1.4
-OH ..	0.25	-0.61	2.6	..
-OCH <sub>3</sub> ..	0.23	-0.50	2.3	<1.5
-Cl ..	0.47	-0.24	1.8	1.0
-Br ..	0.45	-0.22	1.9	0.9
-CH <sub>3</sub> ..	-0.05	-0.13	1.4	..
-CH <sub>2</sub> Cl ..	0.17	0.01	1.0	..
-NO <sub>2</sub> ..	0.63	0.15	<0.3	0.7

values of the coupling constants in *m*-substituted fluorobenzenes show that they decrease significantly with the decrease in the  $\pi$  electron densities in the ring caused by the substituents. In fact a linear behaviour is observed between  $\sigma_R$  which is a measure of the resonance effect causing change in the  $\pi$ -electron densities and  $J_{para}$  (Fig. 1). On the other hand, the couplings do not have any correlation with  $\sigma_I$  values which are a measure of the changes in the  $\sigma$ -electron densities caused by the substituent. Similar trends are observed in *ortho*-substituted compounds although here the variations are not so large. The results therefore indicate the following: (i) The fluorine interaction with the spin of the *para* proton decreases steadily with the increase in  $\sigma_R$  values of the substituents in the ring. Thus the groups, which have a tendency to release electrons on the ring by resonance, increase the *para* proton-fluorine coupling; the coupling is least in the case of the -NO<sub>2</sub> group which is known to be a strong electron-withdrawing group.

The difference in the behaviour of *para* H-F and *para* H-H coupling is conceivable since the fluorine has *p* electrons capable of interacting with  $\pi$  electrons in the benzene ring system, so that fluorine may respond in a quite different way from proton which has no *p* electrons.<sup>3a</sup> (ii) The different slopes (Fig. 1) in the case

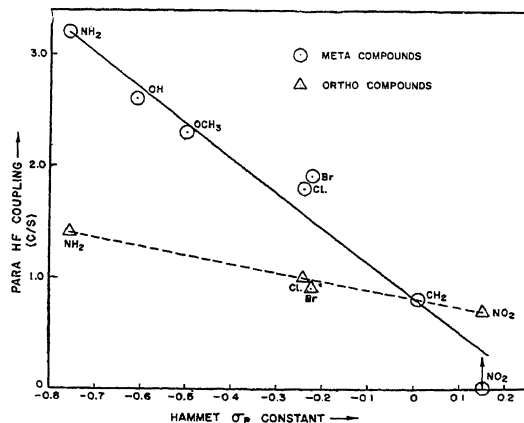


FIG. 1

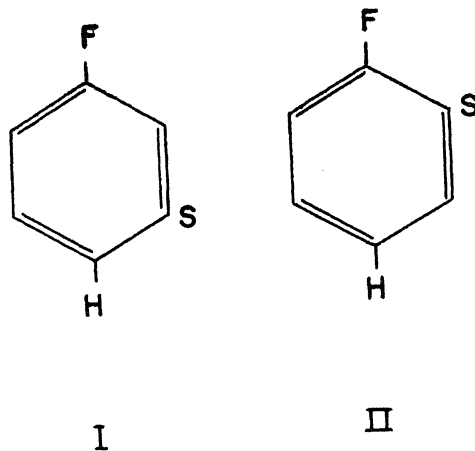


FIG. 2

of *meta* and *ortho*-substituents show that their effect is in general more when the substituent is *ortho* to the proton in question than when it is *meta*. The results show that it is the resonance effect which is more predominant in determining the  $J_{HF}$  (*para*). Since it is known that the resonance mechanism<sup>3b</sup> operates primarily at the *ortho* and *para* positions it can be concluded that the coupling constant is affected more by the effects produced at the proton position (in the case of *meta*-substituted compounds where the substituents are *ortho* to the

para proton) than at the fluorine position (in the case of ortho-substituted compounds).

Our sincere thanks are due to Shri M. R. Das for discussion.

Tata Inst. of Fundamental Res. and Atomic Energy Establishment, Trombay, Bombay-5, August 27, 1962.

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### SEARCH FOR A $0^+$ EXCITED STATE IN $\text{Sr}^{88}$

KISSLINGER AND SORENSON<sup>1</sup> have calculated the low energy properties of nuclei using a model which combines certain important features of the unified nuclear model and the independent particle model with a two-body residual interaction, the residual interaction having two parts—a pairing force and a long-range force. With this kind of interaction they were remarkably successful in correlating the observed experimental data with theoretical predictions.

They predicted that if the observed  $0^+$  excited state in  $\text{Zr}^{90}$  is a two quasi-particle state then one should expect to find a  $0^+$  state near the 1.84 Mev. level in  $\text{Sr}^{88}$ . In this note we describe an experiment carried out to locate such a  $0^+$  state in  $\text{Sr}^{88}$ .

The energy level scheme of  $\text{Sr}^{88}$  is well known and consists of a  $2^+$  first excited state at 1.84 Mev. and a second excited state at 2.76 Mev. having spin  $3^-$ . We have carried out experiments using  $\text{Y}^{88}$  as the source. The spin of  $\text{Y}^{88}$  is most probably  $4^-$ .  $\text{Y}^{88}$  is known to decay predominantly by electron capture to the 2.76 Mev. level. There is also a small branching to the 1.84 Mev. level.

Our search for the  $0^+$  level is based on the following argument. If the  $0^+$  level exists close to but above the 1.84 Mev. level, that state would not be populated either by direct decay of  $\text{Y}^{88}$  or by decay of the  $3^-$  level in  $\text{Sr}^{88}$  at 2.76 Mev. On the other hand, if the  $0^+$  state lay below the 1.84 Mev. ( $2^+$ ) level, then depending upon how far below this state was located one might expect a weak branching to the  $0^+$  level by depopulation of the 1.84 Mev. level through which all the transitions reach the ground state of  $\text{Sr}^{88}$ . One has to remember, however, that the E2 decay of the 1.84 Mev.

level to the hypothesized  $0^+$  level has to compete with the E2 decay to the ground state of  $\text{Sr}^{88}$ . The method employed consists in determining  $\gamma$ - $\gamma$  coincidences between the 0.9 Mev.  $\gamma$ -ray which results from the decay of the 2.76 Mev. level to the 1.84 Mev. level, and any other  $\gamma$ -ray which would connect the 1.84 Mev. level and the  $0^+$  level. Two scintillation counters employing  $1'' \times 2''$  NaI crystals in conjunction with a fast coincidence circuit having a resolving time of 15 nanoseconds were used to look for coincidences. One counter was set to accept the photo-peak of the 0.9 Mev.  $\gamma$ -ray and the other counter scanned the  $\gamma$ -spectrum in coincidence.

No  $\gamma$ -rays were observed. Using the Weiskopf-Moszkowski-single particle formula to estimate the E2 transition probabilities, an upper limit of 100 Kev. can be set on the energy of any  $\gamma$ -ray from the 1.86 Mev. level to the  $0^+$  excited state. This implies if a  $0^+$  level exists it has to lie within 100 Kev. below the 1.84 Mev. level. However, a search for the  $0^+$  state in which E0 conversion electrons were looked for has also yielded a negative result.<sup>2</sup>

Our results indicate that it is not certain whether the  $0^+$  state in  $\text{Zr}^{90}$  is really a two quasi-particle state.

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### SPLITTING OF ENERGY TERMS OF BIPHENYL MOLECULAR CRYSTAL

THE general theory, developed by Davydov<sup>1a</sup> and extended by Craig<sup>1b</sup> for the interpretation of the characteristics of the absorption spectra of monoclinic crystals of the type of Anthracene and Naphthalene, has been applied to the Biphenyl single crystal. The displacement and the magnitude of the splitting of the non-degenerate energy levels into two components having different polarisation characteristics have been calculated for the electronic transition  $^1A_g \rightarrow ^1B_{3u}$  observed by Deb,<sup>2</sup> Coffmann and Mc-Clure<sup>3</sup> and by Krishna Rao<sup>4</sup> at about  $33700 \text{ cm}^{-1}$ . The Biphenyl crystal is monoclinic<sup>5</sup> with two molecules in a unit cell and has a spatial group symmetry  $C_{2h}^{2h}$ . The  $^1A_{1g} \rightarrow ^1B_{1u}$  transition is split into the two transitions  $^1A_{1g} \rightarrow ^1B_{1u}$  and  $^1A_g \rightarrow A_u$ , polarised along  $a$ ,  $c$  and  $b$

directions respectively. The difference between the two levels on the basis of weak coupling model and dipole-dipole interaction is  $8C$ , where  $C$  is the interaction energy  $I_{pq}$  given by the expression,<sup>1b</sup>

$$\int \phi_p' \phi_q |V_{pq}| \phi_p \phi_q' d\tau$$

which in terms of the dipole-dipole interaction<sup>1b</sup> is

$$-\frac{e^2}{r_{pq}^3} [2\cos\theta_{p1}\cos\theta_{q1} - \cos\theta_{p2}\cos\theta_{q2} - \cos\theta_{p3}\cos\theta_{q3}]$$

between two nontranslationally equivalent molecules. The shift of the crystal spectrum from that of the molecular system on this basis is equal to  $2A + 2B$ : where  $A$  and  $B$  refer to interaction energy between translationally equivalent molecules in the  $a$  and  $b$  crystal directions. The calculated shift is  $5.8 \text{ cm}^{-1}$ . The splitting is very small and found equal to be less than  $1 \text{ cm}^{-1}$ , which is consistent with the experimental observations. But in transitions of low intensity such as the one under consideration, the Davydov effect is not the only important one. Second order perturbations alter the splitting especially when a weak and strong absorption are close together as pointed out by Craig. Since no splitting is observed, it would appear that the second-order perturbations are not effective.

The authors are deeply indebted to Prof. K. R. Rao for his helpful suggestions. One of the authors (A. V. K.) is thankful to the Council of Scientific and Industrial Research for the award of a Junior Research Fellowship.

Microwave and  
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## ON THE NATURE OF TWELVE BRANCHED SNOW CRYSTALS

In his classic work on snow crystals Nakaya<sup>1</sup> describes a variety of snow crystal with twelve branches instead of the usual six. He divided these into two classes, P3a-fernlike crystals and P3b-crystals with broad branches. No satisfactory mechanism has been suggested to account for these formations. It is the purpose of this note to propose and explore the possibility that the P3b-crystals at least are twinned formations. Nakaya reports a theory of Shedd that the twelve branched crystal is two hexagonal crystals connected by a short column to form a squat tsuzumi type. This theory is not supported by Nakaya's photographs, neither does it account for observations of angular equality between the branches. Nakaya specimen 338 is the best P3b representation available and will be considered as a typical crystal. It appears that Nakaya's measurements of this crystal are in error; he reports a non-coincident centre and considerable inequality of the inter-arm angles; measurements on the published photograph show a coincident centre and  $30 \pm 1.5^\circ$  equality of the inter-arm angles. The crystal fulfils the morphological requirements for interpenetration twinning. An apparent rotation of one six arm unit in relation to the other gives the necessary mirror relationship required in a twinned crystal.

Tolansky<sup>2</sup> has suggested that the growth of a snow crystal is controlled by the crystal acting as a two-dimensional vibrating system in much the same way as a Chladni plate. Slight differences in the nature of the vibration account for the many variations in the form of the snow crystals. Mary Waller<sup>3</sup> has shown that under certain conditions a hexagonal Chladni plate can produce a figure with twelve-fold symmetry. A similar vibrating system in a snowflake could account for the twinned form and the symmetrical nature of the vibration would account for the angular equality. This twelve-fold symmetry has not been observed in normal ice I crystals; the (0001) etch pits produced by Bryant and Mason<sup>4</sup> were consistently hexagonal in form. The first implication, mentioned by Tolansky, of the mechanical vibration theory was that natural snow crystals being unconstrained in vibration would be more symmetrical than artificial snow crystals. If this is true then the highly symmetrical twelve branched form is only likely to be encountered as a natural snowflake. A study of Nakaya's results shows that this difference is in fact

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observed; his artificially grown snow crystals are not as symmetrical as natural ones.

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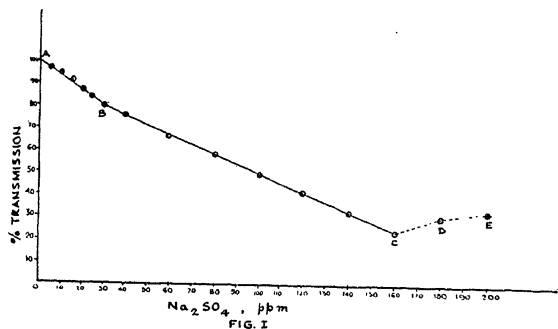
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### A NEW TURBIDIMETRIC METHOD OF DETERMINATION OF SULPHATE IN BRACKISH WATER

A NEW turbidimetric method for the determination of sulphate in brackish water is described. The suspension of barium sulphate is produced in an acidified medium of glycerine-*d*-glucose<sup>1</sup> solution by the addition of barium chloride solution and the turbidity is measured at a wavelength of 450 m $\mu$  by the Bausch & Lomb Spectronic '20' colorimeter. The composition (by weight) of the suspending medium is:—glycerine 50%, *d*-glucose, BDH, 10%, hydrochloric acid, A.R., 2.5%, distilled water, 37.5%.

A standard curve obtained with a solution of sodium sulphate having 1,000 ppm. concentration is shown in Fig. 1.



It is seen that the curve (BC) is linear between 30 and 160 ppm. Below 30 ppm. it deviates slightly and takes up a new linearity namely, BA, but beyond 160 ppm. (point C), the curve breaks off, as shown by points D and E. The change in the direction of the straight line from CB to BA is no doubt due to higher transmission in the low concentration range. The portion AB of the curve can still be used for the determination of sulphate below 30 ppm. The break-off beyond 160 ppm. may be due to gradual settling of barium sulphate in the high concentration range or non-uniformity of particle size or both.

There is no optimum wavelength. The percentage transmission (%T) goes on increasing with wavelength as shown in Fig. 2. The selection of wavelength at 450 m $\mu$  is arbitrary.

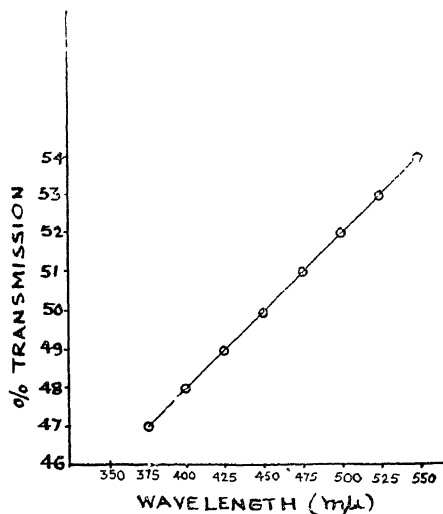


FIG II

The concentration of sulphate in a solution, is calculated by means of an empirical formula.

#### PAIRED COMPARISON

Sulphates in 30 samples of brackish water were determined both gravimetrically as well as turbidimetrically. The gravimetric estimations gave concentration of sulphate as Na<sub>2</sub>SO<sub>4</sub> from 60.8 to 3,309 ppm.

The paired comparison of the two methods, namely phototurbidimetric and gravimetric shows a standard deviation of 19.6 which is not significant, for the value of *t* is 0.0204 which is much below the value for *P* = 0.5.

The method has been successfully used for the determination of sulphate in natural seawater.

The authors wish to thank Dr. P. L. Kapur, Director, for his advice and encouragement.

Defence Laboratory,  
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**$\alpha$ -NITROSO- $\beta$ -NAPHTHOL AS A REAGENT IN GRAVIMETRIC ESTIMATION OF URANIUM AND ZIRCONIUM**

According to Feigl and Stern<sup>1</sup> uranium salts give yellow precipitate on treatment with  $\alpha$ -nitroso- $\beta$ -naphthol, while Bellucci and Savoia<sup>2</sup> have reported that the same reagent precipitate zirconium salts as greenish yellow precipitate in the presence of sodium acetate. In the present communication these reactions have been tried for the gravimetric estimation of both uranium and zirconium. The results obtained in the case of uranium were comparatively better than those obtained by the usual ammonium diuranate method.<sup>3</sup> In the case of zirconium also, the results were better than those by the phosphate method.<sup>4</sup>

**ESTIMATION OF URANIUM**

About 0.1 gm. of uranyl nitrate (A.R.) was accurately weighed and dissolved in about 150 ml. of water and the solution was adjusted to pH in between 4.1 and 9.4. Then it was warmed to about 40°C. and 2% ethanolic  $\alpha$ -nitroso- $\beta$ -naphthol was added dropwise along the side of the beaker, with stirring, till the supernatant liquid was distinctly yellow. The yellow precipitate was digested on a water-bath for about 30 minutes and allowed to settle for about two hours at room temperature. Then it was filtered through Whatman filter paper No. 43, washed with cold water several times and dried on a hot air cone. It was then ignited in a weighed platinum crucible at about 900° to 1000° for about four hours over Meker burner. It was cooled, dried in a desiccator and weighed as  $U_3O_8$ .

The results (Table I) indicate that quantitative estimation is possible for uranium with  $\alpha$ -nitroso- $\beta$ -naphthol. The accuracy of the results was of the same order as that obtained in the ammonium diuranate method.

**TABLE I**

	Wt. of salt taken (gm.)	Wt. of salt found (gm.)
<i>Estimation of uranium</i>		
1	0.0575	0.0573
2	0.0792	0.0793
3	0.1080	0.1080
4	0.1362	0.1361
<i>Estimation of zirconium</i>		
1	0.0487	0.0488
2	0.0858	0.0860
3	0.0977	0.0977
4	0.1236	0.1237

**ESTIMATION OF ZIRCONIUM**

About 0.1 gm. of crystallised zirconium oxychloride (B.D.H. sample) was accurately

weighed and dissolved in about 150 ml. of water. The pH of the solution was adjusted in between 5.5 and 5.9 with hydrochloric acid (A.R.). Then 2% ethanolic solution of  $\alpha$ -nitroso- $\beta$ -naphthol was added dropwise with stirring till the supernatant liquid was yellow.

Greenish yellow precipitate formed immediately and was digested on a water-bath for half an hour. The precipitate was kept for about an hour at room temperature when it settled down and was further worked out as in the estimation of uranium to obtain  $ZrO_2$ .

The results are tabulated in Table I. In the case of zirconium also it was found that the error was of the same order as that obtained in the phosphate method.<sup>4</sup>

Moreover the method is fairly applicable in the presence of Be, Al, Ce, rare-earths, Ti and Th which do not interfere in the above estimations.<sup>2</sup>

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**RELATION OF GENOTYPE WITH ENZYME CONTENT IN PROTOTROPHS OF *ASPERGILLUS NIDULANS***

THE genetic control of enzyme activity had been studied in mutants of bacteria and fungi.<sup>1</sup> However, the comparison between genotype and enzyme activity had been made only in a few cases in *Neurospora crassa*.<sup>2</sup> The genetics of *Aspergillus nidulans* had been worked out in detail by Pontecorvo.<sup>3</sup> The prototroph of *Aspergillus nidulans* exist in three different conidial colours—(a) strains with wild type green (Y); (b) strains with white spores and in particular  $w_3$  located in second chromosome and (c) strains with yellow spores due to the presence of a mutant  $y$ , located in the first chromosome.<sup>4</sup> A detailed and systematic investigation had been undertaken to study whether variation in genotype results in variation in enzyme activity in these prototrophs. The present note deals with a very interesting observation, namely, the absence of the enzyme citric dehydrogenase in the cell-free extract of one of the prototrophs and hence an accumulation of citric acid in the medium during growth,

The organism was grown in liquid minimal medium<sup>3</sup> which had the following composition in g./litre:  $\text{NaNO}_3$ —6;  $\text{KH}_2\text{PO}_4$ —1.52;  $\text{KCl}$ —0.52;  $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ —0.52; glucose—10.0 and traces of Zn and Fe. The pH of the medium was adjusted to 6.5. The media were sterilised at 10 pounds pressure for 15 mts. and inoculated with spore suspension of the prototroph. The culture filtrates of Y, w and y prototrophs were analysed for citric acid content on 3rd, 5th and 7th day of growth by chromatography<sup>5</sup> and quantitatively by Furth-Herrmann reaction.<sup>6</sup> The results are presented in Fig. 1. It can be

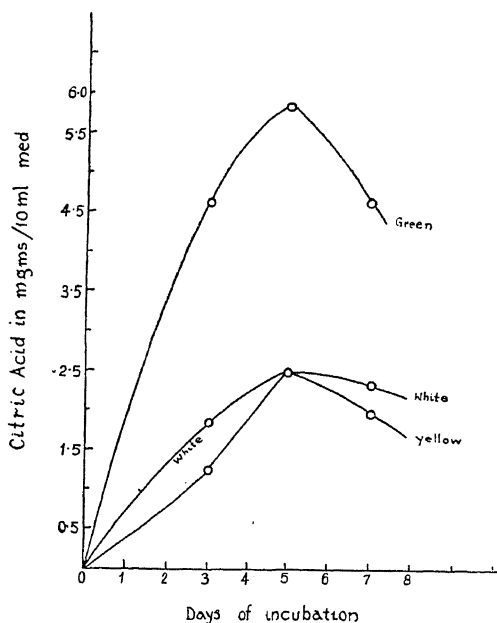


FIG. 1

TABLE I

*Citric dehydrogenase activity in cell-free extract of Aspergillus nidulans.*

Each flask contained 0.190 mg. citrate in 1 ml. of water; 1 ml. of (0.01 M) phosphate buffer of pH 7.0; 1 mg. of cytochrome C; and 0.5 ml. of enzyme extract. Centre well contained 0.2 ml. of 20% KOH. Temperature 37° C.

No.	Time in minutes	Oxygen uptake in $\mu\text{l./mg.}$ Nitrogen of the enzyme extract		
		w prototroph	y prototroph	Y prototroph
1	0	..	..	..
2	30	47.61	..	..
3	60	100.51	75.68	..
4	100	118.0	108.65	..
		(maximum)	(maximum)	
5	150	..	..	Nil

seen from the figure that in the case of Y prototroph there is more accumulation of citric acid. This observation was extended further and the activity of the enzyme, 'citric dehydrogenase' which acts upon citric acid, was studied in the cell-free extract of the three prototrophs by the conventional warburg technique. The experimental details and results are presented in Table I. From the results in Table I, it is interesting to note that only in the case of Y prototroph there is practically no oxygen up-take (various pH had also been tried), indicating that the enzyme citric dehydrogenase may be absent.

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## MICROFLORA OF KAREWA BEDS

THE present note deals with the study of microflora obtained from the maceration of a greenish clay sample collected from the Karewa beds. The material was collected from the locality of Ninghal-nullah of altitude 9,000 ft. by Dr. (Mrs.) S. Chitaley in June 1961. She kindly placed it at my disposal for studying the microfloral contents. Several collections of plant fossils were made in past from Karewas by De-Terra, Sahni, Stewart, Puri and others and were described by them particularly for their megafossil contents.

The clay sample under investigation was taken from interior of a big block and was then finely powdered. Maceration was done with hydrofluoric acid for about an hour. After washing well with water to remove all traces of acid it was passed through different grades of alcohol for clearing and dehydrating. Several mounts were prepared in glycerine jelly. Some of the slides revealed under the microscope very interesting spore-like structures. They were in masses, mostly in chains with individual

structures held together by gelatinous connections (Fig. 1). The number of spores in a chain varies

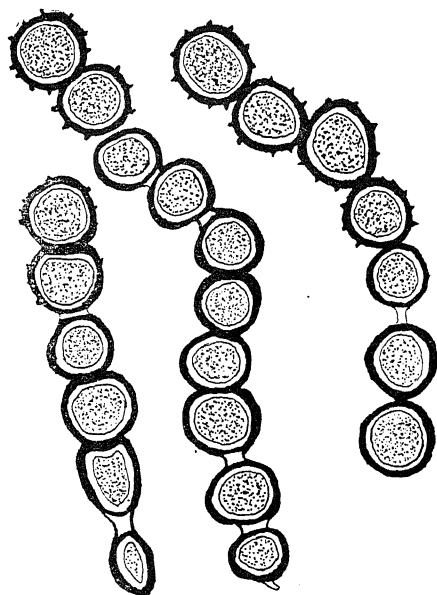


FIG. 1. Spores in Chains,  $\times 833$ .

from 2 to 25 and many spores are seen also in solitary condition which suggests that they are broken out from their parent chains. The shape of the spores is round to very slightly ovoid. Size of the spore on average varies from  $4\mu$  to  $6\mu$  in diameter. Some spores, generally the larger ones, have thick walls with warty exine whereas some, the smaller ones, have thin and smooth walls. The thickness of the exine of the thick-walled spore is  $1.05\mu$ . No definite nucleus was seen, instead a number of granules spread all over the cytoplasm were distinctly observed.

On the whole these structures very much look like conidia or like exogenous spores as seen in Phycomycetes or in some Fungi-Imperfecti. In absence of mycelium or any conidiophore their exact identification with any of the fungal groups is uncertain. The present form can be safely identified as fungi-conidia as seen generally in Monoliales a group of Fungi-Imperfecti. The forms like *Torula*, *Memnoniella*, and *Lacelina* of Monoliales show reasonable comparisons with the present one.

The author is indebted to Dr. (Mrs.) S. Chitaley for her guidance and Shri M. M. Lanjewar, Principal, for providing the necessary facilities. Dhanawate National College, P. N. PUREKAR. Nagpur, April 30, 1962.

### THE GROWTH OF THE SHELL IN *MARTESIA FRAGILIS*—THE WOOD- BORING PHOLAD OF MADRAS

THE features of the shell valves of *Martesia fragilis* have been described in earlier papers.<sup>1,3</sup> It is noticed that in this form, during the growth of the shell, two stages are discernible as has been pointed out by Turner.<sup>4</sup> In the first stage the anterior margins of the valves are uneven leaving a gape in between, which facilitates the foot to protrude and bore into timbers. As the animal grows, a calcareous deposit "callum" is secreted as extensions of each shell valve and these extensions meet in the middle line, resulting in the closure of the pedal gape. So when the adult condition is attained the foot is non-protrusible and the animal cannot bore. Specimens belonging to different sizes measuring 9, 9.3 and 16, 17 mm. were left in bowls of sea-water and their growth was observed under laboratory conditions. They reached a length of 11, 11.5, 17 and 17.5 mm. respectively in about ten days after which the growth in length of the shell ceased. There was no increase in the breadth of the shell. Specimens 1 and 2 which were devoid of callum in the beginning developed a complete callum, which covered the gape between the anterior beak-shaped ends of the valves. It is probable that the callum is formed earlier under laboratory conditions than in its natural environment where it would have continued boring for a further period. A perusal of Table I shows that

TABLE I

Specimen No.	Shell Callum	Length in mm.					
		1st Day	3rd Day	6th Day	10th Day	14th Day	20th Day
1	Shell	9.0	9.5	10	11	11	11
	Callum	0.0	1.0	2.5	3	3.5	3.5
2	Shell	9.3	9.5	11	11.5	11.5	11.5
	Callum	0.0	2.0	4.0	4.0	4.0	4.0
3	Shell	17.0	17.0	17.0	17.5	17.5	17.5
	Callum	3.0	5.0	5.0	5.0	5.0	5.0
4	Shell	16.0	16.0	17.0	17.0	17.0	17.0
	Callum	3.0	4.0	4.5	4.5	4.5	5.0

in specimens where the growth in length has stopped, the callum continues to develop and in forms where the callum has ceased growing, there is an increase in length of the shell. This shows clearly that there is no obvious relationship between the rate of growth of the callum and the shell. Observations for about forty days revealed that there was no growth after the twenty-day period. It is probable that growth would have continued even after this period under natural conditions,

It is also evident that adults of *Martesia* are able to survive on planktonic food<sup>2</sup> and that growth can take place even when removed from their natural habitat, i.e., from wood.

My thanks are due to Dr. C. P. Gnanamuthu and Dr. S. Krishnaswamy for their help and the Forest Research Institute, Dehra Dun, for financial assistance.

Marine Organisms Scheme, V. V. SRINIVASAN.  
Zoological Research Laboratory,  
University of Madras,  
June 16, 1962.

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# **FIRST RECORD OF MEGASTIGMUS DORSALIS (FABR.) (CHALCIDOIDEA: CALLIMOMIDAE: MEGASTIGMINAE) FROM INDIA**

*Megastigmus dorsalis* (Fabricius) is a common and widespread parasite of the Cynipidæ gall-formers in Europe. Its detailed description along with a number of hosts is given by Mayr (1874). Milliron (1949) has published a long list of cynipid hosts, e.g., 16 species of *Andricus*, 1 of *Biorhiza*, 12 of *Cynips*, 3 of *Neurotergus* and 1 species each of *Plagiotrochus*, *Synergus* and *Synophrus*.

In 1955, six examples of this species were bred during August to September from a good collection of acorns of *Quercus semecarpifolia* Smith, collected in July by my son Rajendra Nath from Belcha 8,600 ft., Tons, Chakrata (Uttar Pradesh). This palaearctic species has been recorded for the first time from India. A few examples of *Syntomaspis* sp. new to science were also bred in association with *M. dorsalis* (Fabr.) and their description will be published elsewhere. The true host of *M. dorsalis* requires confirmation by further rearings.

The writer expresses his sincere thanks to the Director, Commonwealth Institute of Entomology, British Museum, Natural History, London, for confirming this species.

The specimens are deposited in the Main Entomological Collection of the Forest Research Institute, Dehra Dun.

49, Lytton Road,  
Dehra Dun, U.P.,  
May 17, 1962.

R. N. MATHUR.

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## **SYNTHESIS OF AMINO-ACIDS IN THE ROOTS OF RICE PLANTS**

It is a well-known fact that the plant root system plays an important role in the transformation of nitrogen compounds. A major fraction of the inorganic nitrogen taken up by the roots is transformed in the roots into organic compounds and as indicated by the analysis of the bleeding sap, mainly amino-acids and amides are transported by the xylem.<sup>1,2</sup> It has been found also that the composition of the bleeding sap depends considerably on factors influencing the metabolism of roots.<sup>3</sup>

The analysis of the bleeding sap of rice plants revealed a number of peculiarities in its composition and, compared to other plants, characteristic differences were observed. The composition of the bleeding sap of different rice varieties is also characteristic and it depends among others on the O<sub>2</sub>-supply in the soil which is highly influenced by irrigation.

In the present studies the rice varieties Dunghan Shali (lowland rice) and Pallagi-73 (upland rice) were used. A wheat variety was induced in the experiments for comparative purposes. The paper chromatograms in Fig. 1 indicate that in the bleeding sap of rice grown in irrigated culture the major amino-acid component is alanine. Under dry conditions the main components are asparagine and aspartic acid in the case of rice and glutamic acid in the case of wheat. It is to be noted that the composition of the bleeding sap of the rice variety Pallagi-73 is similar to that of Dunghan Shali if grown under irrigated conditions.

The marked accumulation of alanine cannot be observed in the shoot even if the rice has been cultivated under irrigated conditions. This is explained, according to our observations, by the intensive operation of the alanine → glutamic acid transaminase system in rice.<sup>4</sup> Thus the alanine accumulated can take part in the overall nitrogen metabolism.

Two pathways of alanine biosynthesis are supposed: reductive amination of pyruvic acid and transamination from glutamine to pyruvic acid.<sup>5</sup> Accumulation of pyruvic acid in both cases is promoted by anaerobic conditions. Removal of pyruvic acid from the Embden-Meyerhof-Parnas scheme at the same time results in accumulation of DPN-H<sub>2</sub> and this



renders possible the reductive amination of  $\alpha$ -ketoglutaric acid, oxaloacetic acid and pyruvic acid respectively.

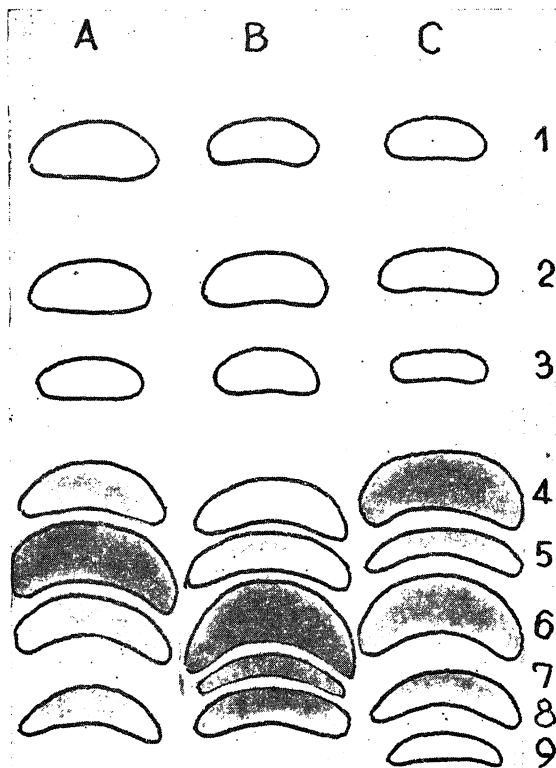


FIG. 1. Amino-acid content of bleeding saps. A = wheat; B = upland rice; C = lowland rice. 1 = leucine or isoleucine; 2 = valine; 3 =  $\gamma$ -aminobutyric acid; 4 = alanine; 5 = glutamic acid; 6 = aspartic acid + glutamine (mainly aspartic acid!); 7 = asparagine; 8 = histidine + arginine; 9 = cyst(e)ine.

Our data may also enlighten the Warburg's thesis: "kein Wachstum ohne Glykolyse".<sup>3</sup> The model of Potter<sup>7</sup> attributes growth to the accumulation of intermediary metabolites. Holzer demonstrated that simultaneously accumulation of DPN-H<sub>2</sub> occurs.<sup>8</sup> This makes possible the reductive amination needed for the building in of nitrogen into organic compounds.

The carbon-skeletons necessary for the synthesis of aspartic acid and asparagine (fumaric acid or oxaloacetic acid) derive from the aerobic Szent Györgyi-Krebs cycle and perhaps this is the cause of the presence of a considerable amount of the above-mentioned

amino-acids in the rice grown under dry conditions in contrast to their presence in much lesser amount in the irrigated rice. Their primary or secondary character is even as problematical as in the case of alanine.

It may be seen from the above results that the transformation of nitrogen compounds in the root and the transport of nitrogen compounds is greatly affected by the environmental conditions, mainly by oxygen. If the field is flooded, the O<sub>2</sub>-supply of the soil is insufficient,<sup>9</sup> and the conditions favour the synthesis of alanine. This might be explained by the inhibition of aerobic respiration and in consequence of this the availability of higher pyruvic acid levels for NH<sub>3</sub> incorporation.

Institute for Plant Physiology, F. ZSOLDOS.  
University of Szeged, J. ZSOLT.  
Hungary, July 7, 1962.

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## HOMOZYGOSITY REQUIREMENTS OF INBRED LINES OF MAIZE

SELFING AND SIBBING are practised in maize breeding to attain uniformity in inbred lines. Variable results have, however, been reported regarding the relative merits of selfing and sibbing as inbreeding methods. This necessitated the study of these methods in relation to homozygosity requirements of inbred lines of maize.

Experiments were conducted with eleven pairs of selfed and sibbed lines in the first generation and thirteen pairs of selfed and sibbed lines in the second generation. The relevant data are presented in Table I.

The sibbed lines, in both the generations, were vigorous, high yielding and early maturing. However, there was a significant difference as regards the coefficient of variability for days to silk shown by these pairs which was higher for the sibbed lines. In the first generation, the sibbed lines were highly lacking in uniformity but they

very much improved in this regard in the second sibbed generation. The greater variability of the sibbed lines is not a desirable character for the production of hybrid seed. This point was also observed by Kinman (1952)<sup>1</sup> who found the sibbed lines to be more variable than the selfed ones in days to silk.

TABLE I

Comparison of selfed vs. sibbed lines of maize

	Plant height (cm.)	Cob length (cm.)	Cob girth (cm.)	100 grain weight (gm.)	Grain yield per plant (gm.)	Days to silk
<i>First Generation</i>						
Selfed lines	.. 157.48	13.56	9.98	14.90	23.81	55
Sibbed lines	.. 190.50	15.95	10.87	15.83	36.86	53
<i>Second Generation</i>						
Selfed lines	.. 167.64	11.07	10.01	12.35	18.71	59
Sibbed lines	.. 187.96	14.15	10.72	13.87	50.18	57

Comparisons were also carried out with selfed and sibbed pairs in other generations for days to silk. Inbred lines in the  $S_3$  generation were compared with  $S_1Sb_2$  lines. The coefficient of variability obtained was 1.69% for  $S_3$  and 1.21% for  $S_1Sb_2$  lines. Here it will be observed that after the first generation of selfing, there was no appreciable increase in uniformity under continued selfing. The slightly lower percentage of variation showed by  $S_1Sb_2$  lines indicates that after the first generation of selfing wherein the differences segregate out very sharply, some residual heterozygosity remains. This residual heterozygosity is responsible for the vigour of the lines. Under continued selfing, this residual heterozygosity is lost, resulting in further loss of vigour; but by sibbing, this residual heterozygosity is maintained and is distributed more evenly than selfing, resulting in a slightly lesser coefficient of variability. This fact has been further supported by other comparisons of  $S_5$  and  $S_4Sb_1$  lines where the coefficient of variability for  $S_5$  was 0.974% and for  $S_4Sb_1$  0.385%.

The results clearly indicate that one generation of selfing is most essential for attaining uniformity of the inbred lines. Further selfing results in loss of vigour without appreciable change in uniformity. On the other hand, sibbing conserves the vigour of the lines. Comparison of  $S_3$  with  $S_1Sb_2$  lines has shown that after the first generation of selfing, the inbred lines should be sibbed and maintained by continued sibbing. This fact has been supported by the views of Wellhausen working in the Mexico Maize Programme. At the Indian

Agricultural Research Institute, there are a number of inbred lines in the double cross-production programme which were selfed only for one generation and maintained further by sibbing.

Central Tobacco

Research Institute,  
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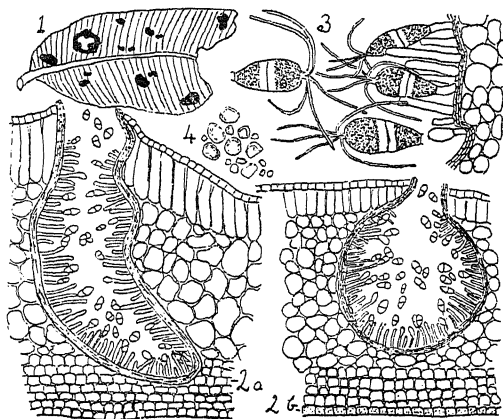
### ON THE OCCURRENCE OF *NEOBARKLAYA NATALENSIS* SYD. IN INDIA

In the course of his survey for ascomycetous fungi in the state of Maharashtra the writer collected living leaves of *Syzygium jambolanum* DC. (*Eugenia jambulana* Lam.) from Mahabaleshwar (4,500 ft. altitude) heavily infected with tar-spot-like lesions. On critical examination, they revealed typical deep-seated well-defined pycnidia with 2-celled, amber-coloured conidia possessing a tuft of uniformly five apical celia. The fungus was identified as *Neobarklaya congesta* (Berk. & Br.) Petch. The fungus has been reported by Butler & Bisby (1960) from India under the name *Neobarklaya natalensis* Syd., but collected on a different species of *Eugenia*, viz., *E. heyneana* Duth. The original description of this interesting fungus as given in Saccardo (1902) refers to the formation of the fruiting bodies of the acervulus type and conidia having 1-3 apical celia. This places the fungus under the form-family Melanconiaceae. A critical examination made of the Indian collection (originally made by Ajrekar in 1912, No. 2199—2-6-1912) obtained from Herb. Orientalis, New Delhi, showed that the Indian fungus was also Sphaeropsidaceous and not Melanconiaceous with conidia possessing 2-4 apical celia.

It is thus desirable to publish a brief but revised description of this rare fungus based on Mahabaleshwar collection.

*Neobarklaya natalensis* Syd., *Hedwigia*, 1899, 38, 134. Syn. *Neobarklaya congesta* (Berk. & Br.) Petch., *Ann. Royal Bot. Garden, Peradeniya*, 1924, 9, 165. *Pestalotia congesta* (Berk. & Br.), *Jour. Linn. Soc. Bot.*, 1875, 14, 89. *Pestalotia evansii*. P. Henn. in *Engler. Bot. Jahrb.*, 1908, 41, 273,

Infection spots dark black, circular, raised, scattered, epiphyllous, as well as hypophyllous (amphiphyllous). Pycnidia globular to cylindric, narrowly ostiolate, sub-erumpent, black, deep-seated,  $215-510 \times 65-164 \mu$ . Conidia 2-celled, oblong, deep amber-coloured, with a hyaline band on either side of the septum, not constricted, thick-walled bearing a tuft of 5 apical cilia and a hyaline 'frill' at base,  $24.0-28.0 \times 9.6-10.75 \mu$ .



FIGS. 1-4. Fig. 1. Habit  $\times$  Nat. Fig. 2. *a-b*. Section through pycnidia,  $\times 132$ . Fig. 3. Conidia,  $\times 285$ . Fig. 4. Crystals,  $\times 220$ .

Inciting tar-spots in living leaves of *Eugenia jambolana* Lam., Mahabaleshwar (India) collected by S. Ananthanarayanan, December 1961.

The Mahabaleshwar collection showed an ascomycetous fungus closely and constantly associated with *Neobarklaya natalensis* Syd. within the same infection spots, probably denoting genetic relationship.

*Eugenia jambolana* Lam. is thus a new host record for *Neobarklaya natalensis* Syd. and the fungus a new addition to the fungi of Bombay, Maharashtra.

The exicatii are being deposited at the Herb. C.M.I., Kew, England and Herb. Crypto Orientalis, New Delhi, India.

The writer is grateful to Prof. M. N. Kamat for his interest and guidance and to the Director for laboratory facilities. He is also grateful to Dr. B. C. Sutton of the C.M.I., Kew, England, for original citations and to Dr. R. S. Vasudeva for the loan of the material and slide from his herbarium.

M.A.C.S. Laboratory, S. ANANTHANARAYANAN.  
Poona-4, March 31, 1962.

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# A LONG-LEAVED MUTANT IN CHILLI (*CAPSICUM ANNUUM* L.)

In 1961, the author observed in a single plant progeny of the chilli variety N.P. Hybrid 5-1-5, a number of peculiar looking plants with long linear leaves. At the early stage of growth these plants had no resemblance to the normal chilli plants. They had shorter internodes and the branching started nearer to the base of the primary branch so that the plant as a whole had a compact, bushy appearance. The most striking feature, however, was the long linear lanceolate ( $9.9 \text{ cm.} \times 0.81 \text{ cm.}$ ) leaves as against the ovate ( $5.7 \text{ cm.} \times 1.9 \text{ cm.}$ ) leaves characteristic of chilli. The leaf margin was wavy and thickened and the leaf bases were decurrent all along the length of the petiole so that the leaves appeared to be sessile. More than one flower-bud was produced in a majority of the leaf axils and the flowering was profuse but only a small percentage of the flower-buds were observed to open. In the flower-buds which failed to open it was noticed that the development of the petals, filaments and style was arrested at an early stage so that they remained small and such buds ultimately fell off. The flowers which opened resembled normal flowers of chilli in all respects except in having shorter styles and filaments. Examination of the pollen from the open flowers in acetocarmine mounts, however, showed complete sterility. A study of microsporogenesis showed that meiosis in the PMC's was normal and all cells showed formation of 12 bivalents. The failure of pollen development was observed to occur during the mitotic divisions in microspores. These plants also appeared to be female sterile as shown by the fact that 125 flowers hand-pollinated with normal pollen failed to give even a single fruit. The main contrasting characters of the mutant plant and the normal plant are summarised in Table I.

The fact that out of a total seedling population of 180, 30 plants with lanceolate leaves were observed appeared to suggest simple monogenic or digenic control.

Recently Cook (1961) has reported a monogenically controlled mutant in *Capsicum annum* designated as mutant-1 phenotype which resembles the mutant described here so far as the leaf characters are concerned. However, no abnormality was noted in the present material with regard to the gynœcium, whereas the mutant described by Cook exhibited considerable malformation of the ovary. Also, while mutant-1 phenotype plants were pollen fertile

TABLE I

		Height at maturity (cm.)	Leaf index 1/w	Xta/cell	Tetrads	Pollen stainable in acetocarmine	Seed Fertility
Mutant	..	28-32	11.8±1.90	19.2±0.86	Normal except 1-2% dyad, monads	None	None
Normal	..	35-40	2.7±0.47	20.5±0.47	All normal	Normal	Normal

the material described here was highly pollen sterile.

I am thankful to Dr. S. K. Jain and Shri S. R. Ramanujam for their useful suggestions.

Botany Division,

B. C. JOSHI.

Indian Agricultural

Research Institute,

New Delhi, May 5, 1962.

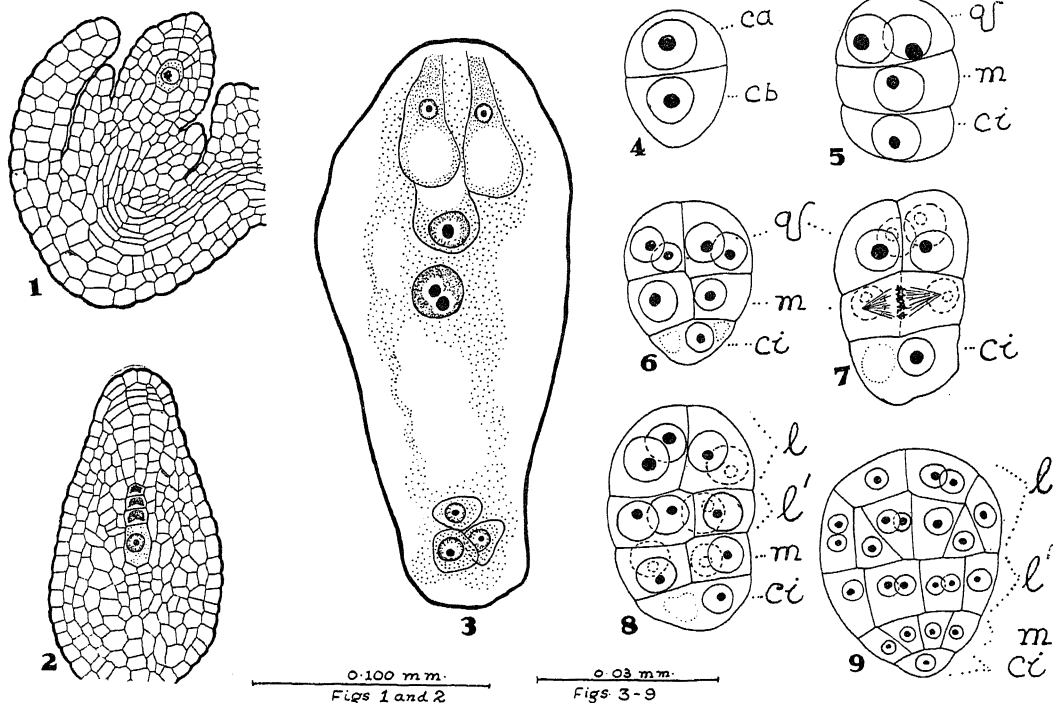
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#### A NOTE ON THE EMBRYOLOGY OF *MICROCOCCA MERCURIALIS* BENTH.

*Micrococca* is one of the genera of the tribe *Acalypheae*<sup>1</sup> of the family *Euphorbiaceae*. The embryology of this tribe is interesting

because of the occurrence of *Penæa* type of embryo-sac development in genera like *Acalypha* and *Mallotus*. There is no previous embryological account for any species of *Micrococca* and the present note records the embryological features of *Micrococca mercurialis* Benth.

The primary archesporium consists of a single row of cells under the epidermis in each anther lobe. The anther wall is made up of four layers of cells, of which the innermost forms a secretory tapetum consisting of binucleate cells. In the mature anther a fibrous endothecium is differentiated. The pollen mother cells divide in a simultaneous manner and cytokinesis takes place by furrowing. Microspore tetrads are usually tetrahedral but occasionally decussate. The pollen grains are shed at the three-celled stage.



FIGS. 1-9. Fig. 1. L.s. ovule showing two integuments, megaspore mother cell and parietal tissue. Fig. 2. L.s. nucellus showing linear tetrad of megaspores. Fig. 3. Mature embryo sac. Figs. 4-9. Stages in the development of the embryo.

There is a single anatropous and pendulous ovule in each loculus of the superior, trilocular ovary. The ovule is crassinucellar and bitegminal. An obturator is developed from the placenta. The primary archesporium in the ovule consists of a single cell. Occasionally however, the archesporium consists of two cells. A parietal cell is cut off which divides further (Fig. 1) to form an extensive parietal tissue. The nucellar epidermal cells also divide repeatedly and a prominent nucellar beak directed towards the axis is formed. The megaspore mother cell undergoes meiosis to give rise to a linear tetrad of megaspores of which the chalazal one is functional (Fig. 2). Development of the embryo-sac conforms to the Polygonum type.<sup>2</sup> The structure and organization of the mature embryo-sac shows no unusual features (Fig. 3).

The endosperm development is of the Nuclear type. It becomes cellular in the advanced stages of the embryo.

The development of the embryo conforms to the Onagrad type and keys out to the Euphorbia variation<sup>3</sup> (Figs. 4-9).

Thanks are due to Professor J. Venkateswarlu for guidance and helpful criticism, to Sri. B. S. M. Dutt for suggestions and to the Government of India for the award of a Research Fellowship during the tenure of which this work has been carried out.

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## PHYSIOLOGICAL STUDIES ON SALT TOLERANCE IN CROP PLANTS

### XVIII. Influence of Sodium Carbonate on Contents of Carbohydrates and Nitrogen in Wheat and Gram

THE influence of the carbonate of sodium on early seedling metabolism and growth up to four days in wheat and gram has been reported earlier.<sup>2-4</sup> A further probe into the effect of the salt on the fractions of carbohydrates and of nitrogen was considered necessary for assessing the differences in crops and between varieties; accordingly the effect of a 'depressing' concentration of 0.2%  $\text{Na}_2\text{CO}_3$  solution on wheat and gram varieties was investigated.

Seedlings of wheat N.P. 165 and C. 591 and of gram N.P. 28 and T. 87 were raised in petridishes on moist filter-papers at 22° C. in darkness; the treated sets received 0.2%  $\text{Na}_2\text{CO}_3$  solution and controls were supplied with distilled water. At the end of 96 hours, the seedlings were analysed for reducing and non-reducing sugars, total and protein nitrogen, adapting the colorimetric methods suggested by Snell and Snell.<sup>8</sup> Ash content of the seedlings was estimated following the conventional 'A.O.A.C.' methods. The results are summarised in Table I.

It is noticed that reducing sugars were lowered in the treated sets of both wheat and gram and so was the case with protein nitrogen; differences in between the two crops and their varieties were apparent, in wheat C. 591 appeared to be affected to a greater extent than N.P. 165 while in gram T. 87 suffered more. Opposite trends were seen in respect of ash content and total nitrogen in the two crops; in wheat a decline in total nitrogen and an increase in ash content of the treated seedling was noticed while in gram it was reversed.

TABLE I  
Effect of  $\text{Na}_2\text{CO}_3$  on fractions of carbohydrates and nitrogen and ash content of wheat and gram seedlings

(Expressed as percentage on dry weight basis)

Observation	$\text{Na}_2\text{CO}_3$ supplied to the seedlings (% solution) Crop and Variety							
	Wheat				Gram			
	N.P. 165		C. 591		N.P. 28		T. 87	
	0	0.2	0	0.2	0	0.2	0	0.2
Reducing sugars	8.40	3.00	15.20	7.40	0.59	0.40	1.75	0.60
Non-reducing sugars	5.40	8.69	3.55	1.59	4.78	3.25	4.52	5.09
Total nitrogen	2.18	1.92	1.80	1.78	2.77	3.58	2.69	2.91
Protein-nitrogen	1.50	1.41	1.15	0.84	2.30	1.84	2.30	2.30
Ash	2.00	2.20	2.30	2.80	3.35	3.35	3.80	3.55

Physiological factors involved in salt-tolerance have recently been reviewed by Bernstein and Hayward<sup>1</sup> and Hayward and Bernstein.<sup>6</sup> Depression in crop growth on alkaline lands (soil contains carbonate and bicarbonate of sodium) has generally been attributed to high pH value of the soil solution<sup>7,11</sup> or to the specific toxic effects of  $\text{HCO}_3^-$  and  $\text{CO}_3^{2-}$  ions.<sup>5,9,10</sup> Wadleigh and Brown,<sup>9</sup> working on bean plants, have suggested that primary effect of  $\text{HCO}_3^-$  ion was through its effect on protoplasmic consistency of the absorbing cells of the root. Steward and Preston<sup>8</sup> reported depression in protein synthesis and bromide accumulation in potato discs by increasing the concentration of  $\text{KHCO}_3$  in the external medium; indirect evidence indicated that respiration and carbohydrate metabolism are depressed. Studies relating to the effect of  $\text{Na}_2\text{CO}_3$  on seedling metabolism in wheat and gram<sup>2,4</sup> revealed that respiration rate (oxygen uptake) and spectra of free sugars present were affected. The present study as well puts forth the evidence that the accumulation of protein nitrogen and of reducing sugars in the treated seedlings is disturbed.

The authors are grateful to Dr. S. Sinha for the facilities and encouragement.

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## TEA LEAF WAX AS A STIMULANT AND FUNGISTAT OF SPORE GERMINATION

MARTIN *et al.*<sup>1</sup> have shown that certain constituents of leaf wax extracted from several varieties of Apple inhibited spore germination in *Podosphaera leucotricha*. The ether-soluble acids in particular possessed considerable inhibitory power. In light of the fact that tea leaf contains appreciable quantities of wax, approximately 1% to 1.5%,<sup>2</sup> a study was undertaken to investigate the influence of the wax constituents on germination of fungal spores. It was deemed the results could be used as a possible index of defence mechanism in different genotypes, varying in susceptibility to foliage diseases caused by fungal pathogens.

The wax was obtained by extracting tea leaves with petroleum ether in a Soxhlet apparatus. 1 g. of the wax was dissolved in 100 ml. ether and dilutions made. On films of wax, obtained by pipetting the wax solutions on a glass slide held at an angle, drops containing spores of *Pestalotia theae* in distilled water were placed and germination recorded. Percentage germination after 16 and 24 hours was markedly greater on wax films from 0.04% to 0.2% solutions, than in the control. Films from 0.01%, 0.02% and 0.4% solutions also stimulated rate of germination, but that from 1% solution proved inhibitory (Table I). At the end of 40

TABLE I  
*Influence of tea leaf wax on germination of  
Pestalotia theae spores*

Treatments (% wax)	% germination after			Average length of germ tube in microns after		
	16 hrs.	24 hrs.	40 hrs.	16 hrs.	24 hrs.	40 hrs.
1. 1.00 ..	7.4	12.8	95.4	3.85	5.77	14.63
2. 0.40 ..	54.1	90.5	96.8	10.62	93.52	160.93
3. 0.20 ..	94.8	96.8	97.2	19.25	140.14	231.00
4. 0.08 ..	93.2	94.9	96.8	17.24	118.58	195.58
5. 0.04 ..	72.0	84.7	95.3	15.92	93.20	199.43
6. 0.02 ..	32.6	54.1	95.1	4.92	37.75	49.28
7. 0.01 ..	24.9	50.7	94.8	5.46	20.35	32.57
8. Control ..	12.8	41.0	93.2	5.65	11.62	30.80

hours germination was comparable in all the treatments, but the length of the germ tube varied considerably. The stimulatory effect of the wax on the growth of germ tube was striking in treatments 2-5 and only at the highest concentration of the wax tried (treatment 1) growth was less than in the control. These results clearly showed that both stimulatory as well as inhibitory properties were concerned in the tea leaf wax and attempts to separate them were made.

A 10% solution of wax in petroleum ether was shaken with equal volume of distilled water (100 ml.) in a separating funnel. The aqueous layer was separated, evaporated *in vacuo* and made up to 1 ml. volume. The concentrate was spotted on strips of filter-paper, developed in *n*-butanol: acetic acid: water (4:1:5) by the method of Rockland and Dunn,<sup>3</sup> the chromatograms air-dried and some left unsprayed, while others were sprayed with 0.1% ninhydrin in *n*-butanol and placed for 30 minutes in an oven at 90° C. A narrow yellow band with  $R_f$  0.07 (a), a large black spot with  $R_f$  0.43 (b) and a narrow violet band with  $R_f$  0.56 (c) appeared on heating the sprayed chromatogram (Fig. 1). Sets of 6 unsprayed chromatograms were cut into 1.5 cm. segments, each lot of 6 corresponding segments taken in 1 ml. distilled water and boiled for 2-3 minutes. After cooling, the extract was seeded with spores of *P. theae* and germination determined. A ninhydrin negative substance in the second segment accelerated germination somewhat, whilst the two ninhydrin positive substances (a) and (c) greatly stimulated germination (Fig. 1). The extract from the portion of the

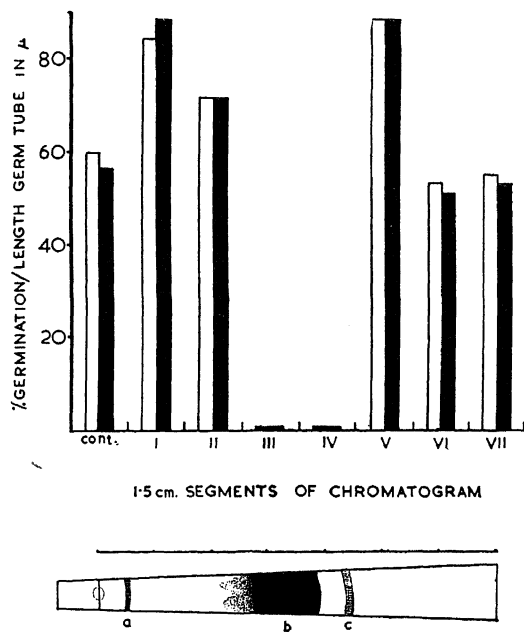


FIG. 1. Percentage germination (empty histograms) and length of germ tube (filled histograms) after 30 hours in aqueous extract of chromatogram segments containing different constituents of tea wax.

chromatogram covered by the black spot (segments III and IV) completely inhibited germina-

tion. This substance (b) was identified as oxalic acid. Based on these results, qualitative and quantitative determination of constituents of leaf wax from clonal types for possible correlation with disease resistance would seem worthwhile.

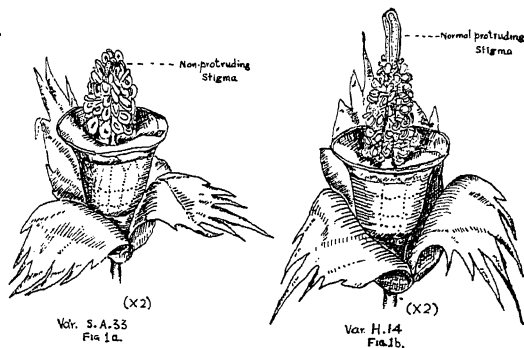
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### A SELF-POLLINATING VARIETY OF COTTON (*GOSSYPIMUM HIRSUTUM* L.)

The Botany Division of the Indian Agricultural Research Institute, New Delhi, has under study and maintenance, a collection of over 600 genetic stocks of Cotton collected from over 28 cotton-growing countries of the world. Some of the items were received through the courtesy of the Indian Central Cotton Committee.

Among the genetic stocks received from the U.S.A. in 1957 through the Committee referred to above, one, namely S.A. 33, is characterized by light-green plant body and leaves and somewhat smaller sized flowers with lemon-yellow-coloured petals and yellow pollen grains. The stigma, which in *hirsutum* cottons, is usually 1 to 1½ cm. long, with a major portion of it protruding beyond the staminal column (Fig. 1 b), does not, in S.A. 33, protrude at all



but remains on level or slightly below the level of the stamens (Fig. 1 a). Self-pollination, therefore, seems to be the rule in the case of this variety, while in other *hirsutum* varieties, natural cross-pollination has been observed to vary from 1.0 to 81.0% as reported from the

U.S.A. (Loden and Richmond, 1951) and from 2.0 to 3.45% as noted in India (Afzal and Khan, 1950). Even when grown for maintenance amidst other *hirsutum* varieties, no off-types have been noticed in progenies obtained from seeds of this variety obtained under open pollination. This appears to be the first reported case of a *hirsutum* variety with a non-protruding stigma.

In a cross between S.A. 33 and H. 14 (with protruding stigma) made in 1959, the  $F_1$  was normal and in  $F_2$  a segregation of 15 protruding: 1 non-protruding stigma was obtained, indicating the operation of a pair of duplicate recessive genes in conditioning the non-protruding nature of stigma. These results are being further confirmed by  $F_3$  studies.

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#### LOCALISATION OF ACID PHOSPHATASE IN *ANABAENA CYLINDRICA* LEMM.

DURING studies on the acid phosphatase activity of algæ (Talpasayi, 1960, 1962) it was noted that the enzyme activity of the intact cells was more intense than in the cell-free preparations, and that there were indications of the localization of the enzyme system on the cell surface. The present report describes some attempts made to visualize the location of the acid phosphatase of the blue-green alga, *Anabaena cylindrica* by the Gomori's technique (Glick, 1949; Pearse, 1960).

*Anabaena cylindrica*, grown in Allen and Arnon's medium, was washed thrice with distilled water and was fixed in cold acetone for 16 hrs. The fixed material was rinsed once in distilled water and incubated in the substrate medium (containing 0.01 M sodium glycerophosphate in 0.05 M acetate buffer, pH 5.0, containing 0.004 M lead nitrate) at 32° C. for 10–16 hrs. The treated material was then rinsed with water and mounted in 1% solution of ammonium sulphide. Material fixed in acetone was found to be very fragile, tending to break up into tiny bits. In some cases, material was directly incubated in the substrate medium without preliminary fixation. Cells heated to 80° C. for

5 mins. to inactivate the enzyme served as controls.

The filaments show brownish-black precipitate of lead sulphide on the surface as a result of the enzyme activity (Figs. 1–3). This surface



FIGS. 1–3. Fig. 1. Filaments of *A. cylindrica* showing the surface blackening of the filaments as a result of deposition of lead sulphide due to the activity of acid phosphatase. Fig. 2. Filaments in the control. Fig. 3. Filament showing absence of lead sulphide deposition in the middle, where the granules of polyphosphates are prominently stained. (Figs. 1–2,  $\times 700$ ; Fig. 3,  $\times 500$ ).

reaction was rather variable, and partly appeared to depend on the age of the cells. At times, filaments may fail to show the surface browning in the middle, which obviously appears to be older than the terminal portions (Fig. 3). In the control, the surface reaction was consistently absent but the cells (except heterocysts and mature spores) showed prominent granules stained black. These granules were found to be identical with the polyphosphate granules as shown by staining with toluidine blue (Talpasayi, 1960). Ebel *et al.* (1958) and



also the present author (unpublished) found that lead nitrate-sulphide reagent specifically stains the polyphosphates in the acid range, pH 3.5. As the substrate medium of Gomori used for the localisation of the acid phosphatase contained the lead nitrate-sulphide, the polyphosphate granules showed the blackening. The granules were also present in the cells which were not inactivated. But, wherever the surface precipitation of lead sulphide was present the cells were found to be devoid of granules inside. It appears, therefore, cells which lack in storage phosphate show positive reaction with Gomori technique. It may be pointed out that in *Euglena gracilis* (Price, 1962), acid phosphatase activity was found to be more pronounced in the cells deficient in phosphate. It is likely that a similar situation exists in *Anabaena* also.

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### MEIOTIC BEHAVIOUR OF A HYPOTRIPLOID INTERSPECIFIC HYBRID OF *SETCREASEA BREVIFOLIA* × *S. PALLIDA*

MEMBERS of the family Commelinaceae are regarded as ideal materials for cytological studies, hence, series of investigations have been conducted in the family by several investigators.<sup>1,2</sup> However, the genus *Setcreasea* is composed of ill-defined and poorly understood taxa. In the course of investigating the chromosomal and genetic homologies among the species of the genus *Setcreasea*, several interspecific hybridizations were attempted to establish the crossability of species. Among the successful hybridizations were crosses involving *S. brevifolia* (Torr.) Sch. & Sydow and *S. pallida* Rose. In a previous report<sup>2</sup> the data on the meiotic behaviour of the parental species was presented. The present note deals with the study of the meiotic behaviour of a  $3n-2$  interspecific hybrid of *S. brevifolia* ( $2n=23$ ) × *S. pallida* ( $2n=12$ ).

Cytological studies were made from microsporocytes by using the aceto-carmine smear

technique. Herbarium specimens with photographs have been prepared and after the study has been completed, these shall be deposited in the Herbarium of this Institution.

The somatic chromosome number of the interspecific hybrid of *S. brevifolia* × *S. pallida* was observed to be  $2n=16$  and it is, therefore,  $3n-2$  (the basic chromosome number of the genus *Setcreasea* being  $n=6$ ).

Meiotic behaviour of this hybrid was studied in detail and the data are given as below:

Univalents (1-8) and trivalents (0-3) were observed besides bivalents (2-6) during metaphase I (Fig. 1). The average chromosome

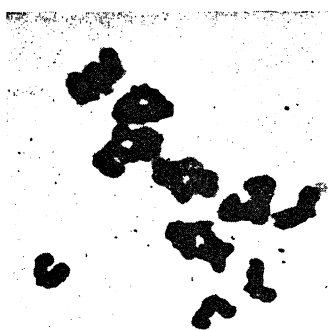


FIG. 1. Meiosis in the interspecific hybrid of *Setcreasea brevifolia* × *S. pallida*, ×1,350. Metaphase I with 6 II and 4 I.

association (per cell) during metaphase I was observed to be 3.30 univalents, 4.49 bivalents and 1.24 trivalents. Chromosome association of 1 univalent, 3 bivalents and 3 trivalents was observed in 6% of the cells, while an association of 4 univalents and 6 bivalents was observed in 20% of the cells (Table I).

TABLE I  
Chromosome associations at metaphase I in the interspecific hybrid of *Setcreasea brevifolia* × *S. pallida*

Chromosome associations			Number of cells
I	II	III	
1	3	3	5
2	4	2	12
3	2	3	5
3	5	1	25
4	3	2	6
4	6	..	14
5	4	1	2
6	5	..	5
8	4	..	1
			Total = 75

Successive stages of meiosis were observed to be irregular. These irregularities were the

presence of lagging chromosomes (dividing and non-dividing), irregular chromosome distribution to the two poles, chromosome bridges and fragments at anaphase I and telophase I and lagging chromosomes at anaphase II and telophase II. Micronuclei (1-3) were observed in 30% and 35% of the cells at the dyad and tetrad spore stages respectively. Six to ten chromosomes were observed during pollen mitosis.

The present hypotriploid ( $3n-2$ ) hybrid was produced by crossing *S. brevifolia* ( $2n=23$ ) with *S. pallida* ( $2n=12$ ). During pollen mitosis a regular formation of 6 chromosomes was observed in *S. pallida*, while 9 to 13 chromosomes were noticed in *S. brevifolia*.<sup>2</sup> It would seem more likely that the present hybrid possesses 10 chromosomes of *S. brevifolia* and 6 chromosomes of *S. pallida*.

At metaphase I 20% of the cells were observed to have an association of 6 bivalents and 4 univalents. The question arises whether the pairing observed during metaphase I is between the chromosomes from one of the two genomes of *S. brevifolia* with those from the genome of *S. pallida* or outosyndesis might prevail wholly or partly among the 10 chromosomes of *S. brevifolia*. It is suggested that 6 bivalents are due to the pairing between the 6 chromosomes of *S. pallida* with 6 chromosomes of the one of the two genomes of *S. brevifolia* since the frequency of quadrivalents was observed to be low in the parental *S. brevifolia*. Furthermore, it may be pointed out that an association of 1 univalent, 3 bivalents and 3 trivalents was observed in 6% of the cells (Table I) in this hybrid studied as above. The presence of three trivalents would suggest certain degree of homology between the two genomes of *S. brevifolia* with a genome of *S. pallida*, and also within the two genomes of *S. brevifolia*. It seems that these two species are closely related and that the two genomes of *S. brevifolia* are in an active stage of chromosomal evolution.

Further work is in progress to obtain  $2n=18$  hybrids between these two species and it is hoped that the cytological analysis of such hybrids shall provide additional data to draw conclusions regarding the interrelationships between these two species.

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## NEW RECORDS OF SOIL FUNGI FROM INDIA

DURING the course of a study of the fungal flora of the 'Usar' soils, *Penicillium brevi-compactum* Diercks and *Mycotypha microspora* Fenner, both of which are hitherto unrecorded from Indian soils, have been isolated from samples collected at different depths from the Banthra Extension Nursery of National Botanic Gardens, Lucknow (India). The soil samples, from which isolations have been made, have an average pH range of 9.24 to 9.95, and an average moisture content of 2.35 to 6.99. For isolating the fungi, Waksman's<sup>1</sup> soil dilution plate method was followed, and the cultures have been maintained in synthetic nutrient agar slants. Morphological and systematic considerations of the isolated fungi are presented below:

*Penicillium brevi-compactum* Diercks (Asymmetrical-Velutina Group<sup>2</sup>): Colony is velvety, lanose, reaching a diameter of ca. 30 mm. in 8-10 days at 25-30°C. on Czapek's Dox agar. It changes its colour from dull-gray to gray-green shades, the reverse of the colony being dull-yellow throughout. Conidiophores are hyaline, erect, quite rigid, ranging from 250-500  $\times$  3.5-5  $\mu$ , with a swollen apex, septate and with slightly rough walls. Penicilli are long, asymmetrically arranged, length about 40-50  $\mu$  with branches mostly 10.5-18  $\times$  3-4  $\mu$ , and metulae 3 to 5 in number. Metulae are 10-15  $\times$  2-3.5  $\mu$  and the phialides are about 9-12  $\times$  2-3  $\mu$ . Conidia are globose to subglobose, ranging in size from 3-4  $\mu$ , and adheres together in a mass.

*Mycotypha microspora* Fenner (Fig. 1).—The fructifications are at first dull-white, become darker at maturity and change from dull-gray to slate-gray in colour. The fungus is extremely heliotropic. The vegetative hypha is much branched, varying in size, and with either densely granular or often vacuolated protoplasm. The thallus is usually coenocytic but septa often appear in old cultures. The capitellum resembles a miniature *Typha* plant in shape. Sterigmata are minute and appear as small, granulate protrusions on the surface of the

capitellum. The capitella vary in length from 30–400  $\mu$ . Capitella of three-day-old cultures measure 250–300  $\times$  17–25  $\mu$ . The conidiophores are mostly non-septate, but several septa appear after 2 to 4 days at an interval of 6–10  $\mu$  (Fig. 2). The conidia are minute, usually hyaline, rarely with a bluish tint, and range in size from 2–4.5  $\mu$ . The germination of the conidiospores takes place within 24 hours.

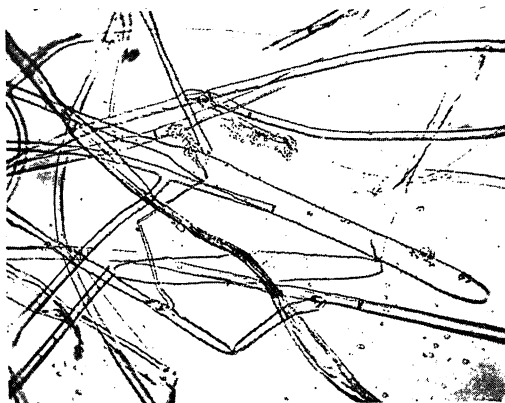


FIG. 1. Photomicrograph of *Mycotypha microspora* Fenner, showing capitellum.

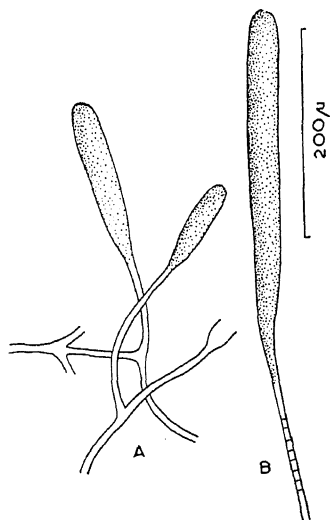


FIG. 2. (a) Young capitellum. (b) Capitellum with septa.

The systematic position of *Mycotypha* is uncertain. Originally isolated as a laboratory contaminant, the genus has been placed in Mucoraceae by Fenner.<sup>3</sup> The finding of a new species *M. dichotoma* has been doubted by Wolf<sup>4</sup> for the conidial stage of *Plicaria fulva*, coming under Moniliaceae. Also the genus *Mycotypha*

has been considered to be a near relative of *Microtypha* of Spegazzini,<sup>5</sup> which is now relegated to a different genus, namely *Arthrimum*.<sup>6</sup>

The fungi have been found occurring at various depths of soil. *Penicillium brevi-compactum* occurs from the surface down to 18" depth while *Mycotypha microspora* occurs from 6–24" depth.

The authors are grateful to Professor K. N. Kaul, Director, for his keen interest in this work. Thanks are also due to Shri P. D. Tyagi, University of Rajasthan, Jodhpur, for the help rendered during the course of the study.

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#### NATURAL OCCURRENCE OF GRAM RUST IN UREDIAL STAGE ON *TRIGONELLA POLYCEPERATA* L., IN SIMLA HILLS

GRAM RUST—*Uromyces ciceris-arietini* (Grogn.) Jacz.—is known to occur in North India as well as parts of Maharashtra and Madras States.<sup>1–3</sup> It has been shown by Saksena and Prasada<sup>3</sup> that the Leguminous weed—*Trigonella polycerata* L.—is capable of functioning as a collateral host inasmuch as under artificial conditions this weed gets heavily infected on inoculation with gram rust. This plant is widely prevalent in the Himalayas up to an altitude of 1,820 m.

During the course of a survey in the Simla Hills, in April 1959, natural rust infection on *T. polycerata* was observed at Parala Farm which is situated at an altitude of approximately 1,500 m. in the Giri valley of Himachal Pradesh. The uredia on the leaves were found to be rather sparse, usually hypophyllous and separate, and brown in colour. Younger pustules were roundish while well-developed ones were oblong or oval and measured up to 3 mm. in length. The urediospores were more or less spherical (21–27  $\mu$  in diam.), dark chestnut brown, with a thick and minutely verrucose epispore consisting of 6–8 scattered germ pores. A comparison was made with a uredial culture

of true gram rust. Morphologically, the uredia and urediospores were found to agree closely with those of the gram rust.

In cross-inoculation and host range studies it was found that the *Trigonella* rust found in nature at Parala readily infected gram plants. Likewise, *T. polycerata* was found to be fully susceptible to gram rust. However, both—*méthi* (*Trigonella foenum-græcum* L.) and *Lathyrus sativus* L.—failed to get infected with both the cultures. On *méthi*, apart from some flecking on the leaves, occasionally minute uredia surrounded by chlorotic areas were also produced.

This finding of natural infection of *U. ciceris-arietini* on *T. polycerata* in the Simla Hills supports the view of Saksena and Prasada<sup>3</sup> that the rust is capable of perpetuating itself on *T. polycerata* in the hilly areas. Gram is grown, though only on a minor scale, in the hills up to an altitude of 1,500 m. At Parala also a few gram plants sparsely infected with *U. ciceris-arietini* were observed. These plants, however, were growing in a field situated at a slightly higher elevation than the place where *T. polycerata* plants were found. It is worthy of note that even though *méthi* belongs to the same genus, *Trigonella*, it was not found susceptible to either the gram rust culture or to that found on *T. polycerata* at Parala.

I am grateful to Dr. R. S. Vasudeva and Dr. R. Prasada for their guidance and to Mr. V. C. Lele for his suggestions.

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### TAXONOMIC NOTES ON THE GENUS *AVICENNIA* L.

*Avicennia* is the only known genus of the tribe Avicenniæ under Verbenaceæ (Bentham and Hooker, 1876). Briquet (1897) similarly includes the genus under the subfamily Avicenniaceæ of Verbenaceæ. However, Lawrence (1951) observes that, "Moldenke, following Endlicher, Eichler and others, accepted Avicenniaceæ as a family distinct from the Verbenaceæ on the basis of wood anatomy, arti-

culate branches, imbricate scale-like prophylls, the free central placentation, and the pendant orthotropous ovules". It has been shown that the situation in regard to the pendant and orthotropous nature of the ovules in *Avicennia* is a feature also shared by several other members of the Verbenaceæ (see Junell, 1934 and Padmanabhan, 1959). Even though the genus differs from other members of the family in wood structure, there are a number of other features which are distinctly verbenaceous. The regular nature of the flower is only apparent. The genus does not exhibit a true free central placentation as conceived by Moldenke. The central column exhibits four wings of which two opposite ones are fused with the ovary wall at the base of the gynoecium. The other two represent false septa characteristic of a number of verbenaceous species. In so far as placentation is concerned the genus *Avicennia* is typically verbenaceous. The unilocular nature of the ovary is caused by the separation of the septa from the wall at higher regions. Furthermore, the orthotropous nature of the ovule is only an apparent condition. The tenuinucellate condition of the ovule of *Avicennia* is again typically verbenaceous. The embryo-sac follows the Polygonum type of development which is characteristic of all the genera of the family so far investigated.

The articulate nature of the branches of *Avicennia* although perhaps a distinctive feature of the genus does not appear to be an exclusive character separating it from the family Verbenaceæ. Because, it is a well-known taxonomic character that the so-called articulation or the condition commonly described as 'jointed nodes' occurs in varying degrees in other members of the Verbenaceæ as well, for example, species of *Vitis*, *Clerodendron*, *Tectona*, etc.

So far as the early development of the endosperm is concerned, the sequence of wall formation following the divisions of the primary endosperm nucleus conforms to the general condition in the Verbenaceæ (Padmanabhan, 1959). The first division is invariably followed by the laying down of a transverse wall. In all the members of the Verbenaceæ so far investigated, the primary chalazal chamber acts as the initial of the chalazal haustorium whereas the micropylar chamber undergoes one more division before the initial of the micropylar haustorium is formed. The endosperm tissue develops as a result of the successive divisions of the central cell of the three-celled stage. Vertical divisions of the haustorial initials is a feature commonly

encountered in the species so far investigated. In *Avicennia*, the micropylar haustorium becomes two-celled due to a vertical division of its initial. However, the haustoria in *Avicennia* do not have an equal in any of the verbenaceous species so far studied; it is quite possible that there may be other genera that might possess similar haustorial structures and eventually prove that *Avicennia* perhaps stands at one extreme in the series. In other words, the morphological modifications and degree of aggressiveness in the haustorial activity of *Avicennia* appears to be more of a quantitative variability than of a qualitative one as compared with other members of the family. Thus, a summation of embryological characters does not warrant the creation of an independent monotypic family to accommodate the genus *Avicennia*.

Department of Botany, D. PADMANABHAN.  
Presidency College,  
Madras, May 10, 1962.

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2. Briquet, J., "Verbenaceae," In Engler's *Natürlichen Pflanzenfam.*, 1897, 4 (3 b), 132.
3. Lawrence, H. M., *Taxonomy of Vascular Plants*, MacMillan, 1951.
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### A NOTE ON THE "MAGIC" TOP

THE theory of a hollow plastic top sold in Holland under the name "Tippetop" and in France under the name "Toupie Magique" has been discussed by C. M. Braams of Utrecht.<sup>1</sup> The peculiar property is that when spinning on a horizontal plane, the stem, which originally points upwards, moves away from the vertical while continuing to rotate about this direction, until it touches the supporting plane whereupon the top quickly rises on the stem and continues its rotation in this normally unstable position.

A similar behaviour is shown by solid wooden tops made by us, at the Indian Institute of Technology, Kharagpur, the shape of which is not precisely defined but corresponds in general to that shown in Fig. 1. The necessary criteria are that the centre of gravity G should lie eccentrically with respect to the axis of symmetry, and the stem should touch the supporting plane (Fig. 2) before equilibrium conditions are reached.

This effect is due to the friction arising when

the point of contact slides over the supporting plane on account of angular momentum. This is explained in a simple way<sup>2,3</sup> by considering precession. If we try to rotate an object, already spinning about a certain axis, about a new axis, the effect is to send its spinning axis towards the direction of the new axis. Hurrying on the precession (on account of the spin, so long as it is great enough) will cause the object to rise in opposition to gravity. When the stem touches the supporting plane, while the top is still rotating, the effect due to the eccentricity of the centre of gravity is strengthened and the top rises on the stem and continues to rotate (Fig. 3) about the unstable

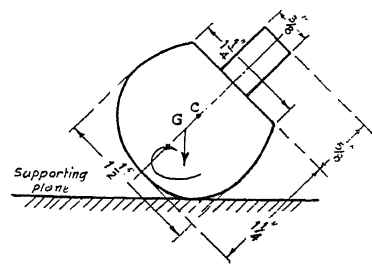


FIG. 1

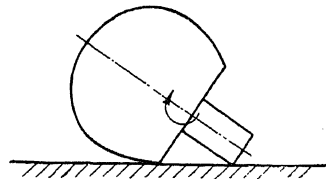


FIG. 2

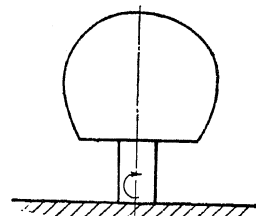


FIG. 3

axis due to friction at the point of contact with the supporting plane.

Indian Institute of Technology, Kharagpur, W.B., India,  
June 14, 1962.

1. Braams, C. M., "The symmetrical spherical top," *Nature*, 1952, 170, 31.
2. Copley, G. N., "The symmetrical spherical top," *Ibid.*, 1952, 170, 169.
3. Perry, J., *Spinning Tops*, Sheldon Press, London, 1929, p. 67.

## REVIEWS

*Reports on Progress in Physics* (Vol. 24). (Published by the Institute of Physics and the Physical Society, 47, Belgrave Square, London S.W. 1), 1961. Pp. 424.

The volume under review of the *Reports on Progress in Physics* for the year 1961 contains the following eight articles: (1) The theory of the superconductive state by H. Frolich, (2) High current gas discharges by A. A. Ware, (3) Cosmic radio-waves and their interpretation by J. L. Pawsey and E. R. Hill, (4) Magnetic domains by D. J. Craik and R. S. Tebble, (5) Photoelectronic image intensifiers by J. B. McGee, (6) Ferrimagnetism by W. P. Wolf, (7) Theory and applications of the density matrix by D. Ter Haar and (8) The dynamics of high temperature plasmas by W. B. Thompson. In this review we shall only indicate the main contents of each article. Each article is authoritative and takes the reader to the latest developments in the particular field.

Amongst the theories of properties of solids the theory of superconductivity has played a unique role. Discovered in 1911 by Kamerlingh-Onnes this phenomenon did not find any satisfactory and consistent theoretical explanation for a long time, and even now it cannot be said to be a completely understood phenomenon. The first break-through in the explanation occurred in 1950, when Frolich, based on the field theory of solid state physics, brought in the electron-phonon interaction into the treatment of superconductivity. According to this the ions of the lattice—or more strictly the lattice vibrations in their quantized normal modes (phonons)—play an important role in determining the energy levels of the electrons in the solid. Thus superconductivity, like many other processes in solid state physics, should find its natural explanation based on the interaction which exists between the electron system and the lattice vibrational field. This interaction is naturally temperature-dependent. Now we know that the electron-phonon interaction which at higher temperatures is responsible for ordinary conductivity can, at very low temperatures, lead to an extremely small energy change connected with the setting-up of an energy gap and with a violent change in most electronic properties.

High current discharges are taken to be those discharges where self-magnetic fields play an

important role in their behaviour. Such discharges have been studied in connection with the quest for controlled thermonuclear reactions. In this article the author, following a historical introduction, presents a set of plasma equations and explains the physical concepts associated with the theory. The author also discusses pinch discharges and magnetohydrodynamic stability in plasma theory.

The discovery of radio-waves from cosmic sources has opened an exciting chapter in astronomy. In the third article the authors present the main contributions of radioastronomy to our understanding of our own galaxy and other external galaxies, and show how the discovery of radio galaxies has provided a fresh approach to cosmology.

The article on Magnetic Domains reviews the recent methods of investigation of ferromagnetic domains and discusses the main results obtained in relation to domain structure, domain nucleation and magnetization processes. Examples of the application of methods using Bitter patterns, electron microscopy and magneto-optic effects are given for a wide variety of materials ranging from metallic single crystals to polycrystalline ferrites.

McGee confines his article on photoelectronic image intensifiers to intensification methods using free electrons. Thus he deals with single- and multi-stage image intensifiers, and positive feedback image intensifying systems. Outlines of the use of image tubes in astronomy, nuclear physics, spectroscopy and radiology are indicated.

The sixth article is an excellent review article on the physical properties of ferrimagnetic materials and their applications in science and industry. Ferrimagnetics being mostly non-conductors of electricity, unlike the ferromagnetic substances, enable experiments to be carried out over the entire range of the electromagnetic spectrum without interference from eddy currents. Thus bulk samples can be used for investigation even at high frequencies, and this has important technical applications.

Density matrix is a mathematical technique whose importance and application in various branches of physics are growing. It was first used by von Neumann to describe statistical concepts in quantum mechanics. The author gives in this article the general properties of

the density matrix including a discussion of Green function techniques which find application in a number of many-body problems.

Research in plasma dynamics has attained increased stimulus in recent years because of the technological promises it offers. Of course the most spectacular is the hope of the controlled release of energy from thermonuclear reactions. Professor Thompson in this last article of the volume deals with the idealised plasma and describes the theoretical models that have been studied in an attempt to understand plasma dynamics. Because of the author's special interest in thermonuclear research, the bias throughout the article is towards the study of plasma stability.

A. S. G.

**The Metallurgy of Welding.** By D. Seferian, Translated by E. Bishop. (Chapman and Hall, London), 1962. Pp. 375. Price 70 sh. net.

The book under review, which can be considered as a very significant and comprehensive progress report on our present knowledge on the subject of welding metallurgy, is a translation of an original French publication. The author brings in between two covers exhaustive information on the relationships between structure, phase transformations and thermal welding cycles, gas absorption weld decay and cracking and the determination of preheating temperatures by mathematical methods. Though the text in this book naturally reveals an accent on French research, important and pioneering work in the field from other parts of the world also finds a place.

This monograph has been conveniently divided into 2 parts, the first containing seven chapters and the second five chapters.

In Part I, the author initially surveys the various welding processes, under the first chapter and proceeds to describe the metallography of the structural constituents of steel and the iron-carbon equilibrium under the second. Under Chapter 3, the mechanism underlying the formation of various microstructures in welds is explained using the isothermal and continuous-cooling transformation diagrams. The formation of Widmanstätten and columnar and other particular structures are also described. In Chapter 4, is developed the basic concepts of the metal-slag equilibria which have special significance in the understanding of the metallurgical role of the electrode in arc-welding and in the consequent design, development and use of electrodes.

Under the caption the absorption of gas by welds, in Chapter 5 the significance and behaviour of gases like Oxygen, Nitrogen and Hydrogen as shown from the most recent researches are described as the present understanding of the harmful role of gases in general and specially the mechanism of hydrogen embrittlement and cracking is rather vague and inconclusive. Then follows a chapter on the disturbing and major problem of cracking succeeded immediately by some significant details on the ameliorating treatment known commonly as 'preheating', especially their causes and determination variables, viz., the popular B.W.R.A. method and the novel Seferian method.

Part II of the book opens with Chapter 8 on the various practical metallurgical and technical weldability tests for the elucidation of the susceptibility of steels to brittle fracture, and some significant details on the concept and utility of the 'brittle transition temperature'. Chapters 9 and 10 deal with the study of the weldability of carbon steels and austenitic chrome nickel steels as a function of their chemical composition and the thickness of the components. Equipments operating above 600° C. and high pressures encountered in power stations necessitate the study of the problem of welding under a totally new dimension and the role and significance and utility of special alloy steels of Nickel Chromium and Molybdenum and lately of newer ones like Boron are discussed at length under Chapter 11, and the heat-resisting low alloy chromium-molybdenum and of special significance to the petroleum and pressure vessels industries and the use of chrom-molybdenum steels in the aircraft industry are dealt with in the last chapter.

This book though aimed primarily towards the serious researcher and user, the welding engineer, it is of no mean significance to the producer, the steel-maker. The volume is exhaustively illustrated by over 320 figures which includes some excellent reproductions of 130 photomicrographs.

A. A. KRISHNAN.

**Mathematics in Science and Engineering.** (Vol. 4)—*Stability by Liapunov's Direct Method with Applications.* By J. L. Salle and S. Lefschetz. (Academic Press, New York; India: Asia Publishing House, Bombay-1), 1961. Pp. vii + 124. Price \$ 5.50.

Whilst linearity is a specific property defined by the theorem of superposition, non-linearity can only be described as a "non-specification",

As such, the generalisation of solutions of non-linear differential equations becomes exceedingly difficult. The two techniques most commonly used in the study of non-linearities—the first-harmonic approximation and the topological or phase-plane plot rely on linearisation or step-by-step geometrical studies.

The only known analytical technique, that could be said to be universal in application, is due to Liapunov. First published in 1892, it has been applied extensively in Russia, but the first Western translations appeared only in 1907 in French and in 1959 in German. The book under review is claimed to be the first comprehensive account of the technique published in English. The basic philosophy of the method lies in choosing a function to satisfy certain simple conditions; conclusions about the stability of the system are derived by examining the derivative of this function. The concept is simple and the result general. It makes it possible to specify a domain in which stability can be guaranteed under all disturbances or to define what disturbances would cause instability. However, one does not easily appreciate how these functions could be defined for a given system and the many examples quoted only tend to confirm the fear that the choice of a Liapunov function is a matter of intuition and skill on the part of the designer. The method does not seem to be very useful for system synthesis and, like all analytical solutions, becomes difficult for all but the simplest problems.

The opening chapters form a sketchy, though useful, review of the mathematical background of vectors, matrices, topology and differential equations, that is essential for the study. The Liapunov function is then introduced, rather abruptly and with barely sufficient explanation. The usefulness of the method, however, becomes readily apparent, when it is used to examine a number of classical non-linear equations the solutions of which are now well established. The Lur'ye transform which enables one to determine the Liapunov function for a certain class of non-linearities is discussed. The authors list together most of the applications of the method used for the study of control systems for the description of Lagrange stability, boundedness and forced oscillations. They also appreciate the weakness of the solution, in that it is unable to define the degree of stability and have indicated the possibility of using the method to determine, what they term, "practical stability" as opposed to "mathematical stability".

The monograph is fourth in a series dealing with Mathematics in Science and Engineering. It will, undoubtedly, provoke new thinking on the possibilities of the Liapunov criterion. The authors would have been assured of success and would have, indeed, done greater service had they included in their all-too-scanty bibliography, references to the papers by Lur'ye, Malkin, Antosiewicz, Ajzerman, Pestel, Okamura, Yoshizawa and many others whose contribution to the subject have been referred to in the text.

PREM J. BHATT.

#### Reference Electrodes, Theory and Practice.

Edited by David J. G. Ives and George J. Janz.  
(Academic Press, Inc., London), 1961.  
Pp. xi + 651. Price \$ 20.00.

Research workers in the field of electrochemistry are often handicapped for want of an exhaustive and critical account about the reference electrode systems. There are excellent texts dealing with the theoretical aspects of electrochemistry, but, these lack in the experimental applications. As a contrast, some texts dealing with experimental portions, limit themselves, to the barest minimum with respect to theory. The book under review is a happy combination of both the theoretical and also experimental aspects of reference electrodes. In their introductory chapter the two editors have done full justice to theoretical aspects of the subject including the thermodynamic aspects of electrode potentials, liquid junction potentials, reversible and irreversible electrodes and some common experimental problems met with, in the measurement of the electrode potentials. The following reference electrodes are dealt with in the next eight chapters: (1) The hydrogen electrode (G. J. Hills and Ives), (2) The calomel and the other mercury-mercurous salt electrodes (Hills and Ives), (3) The silver-silver halide electrodes (Janz), (4) The glass electrode (R. G. Bates), (5) The quinhydrone electrode (Janz and Ives), (6) The oxide, oxygen and sulphide electrodes (Ives), (7) Electrode reversible to sulphate ions (Ives and F. R. Smith) and (8) Membrane electrodes (Hills). In all these chapters a critical evaluation of the electrode potentials, including the theory and applications, has been presented. The next chapter (Hills) deals with the reversible reference electrodes in individual non-aqueous organic solvent systems, like hydrocarbons, acetone, diethyl ether, etc. Electrode systems involving liquid ammonia, sulphur dioxide and hydrogen fluoride are also



outlined in this chapter. Chapter XI contributed by D. B. Carter and I. A. Silver makes a fascinating and instructive reading both to the physical chemist and also to the biologist. In this chapter the physical chemist would admire the technical developments in the measurement of electrode potentials with serious limitations of quantities, space and other specific biological effects. The last chapter (R. W. Laity) on electrodes in fused salt systems is equally interesting.

The book will be a very valuable guide both to the graduate student and also to the research worker in the field of electrochemistry.

M. R. A.

#### Flourescence Assay in Biology and Medicine.

By Sidney Udenfriend. (Academic Press, New York, London), 1962. Pp. x + 505. Price \$ 14.00.

The book under review deals with the subject of application of flourescence assay in biology and medicine. The progress that has taken place in instrumentation for flourescence assay during the last ten years has been so rapid that the available texts, some published as late as 1953, have become out of date. This volume consists of fourteen chapters. The first four chapters deal with the principles of flourimetry and instrumentation. The remaining chapters are devoted to the application of flourescence assay to several groups of compounds of biological interest such as amino-acids, proteins, vitamins, coenzymes and enzymes, steroids, drugs, etc. This volume will prove highly valuable as a manual of reference to research workers in biochemistry and in various fields of biology and medicine.

M. SWAMINATHAN.

**Viruses.** By K. M. Smith. (Cambridge University Press, 200 Euston Road, London N.W.1), 1962. Pp. 134. Price 21 sh. (Paper 12/6 net).

Viruses are of interest not only to the botanist, the entomologist, the doctor and the veterinarian but also to research scientists in molecular biology and biochemistry. Although records of virus diseases, e.g., smallpox and yellow fever take us back to antiquity, yet the first virus, the tobacco mosaic virus, was described only in 1892, and the first animal virus, foot and mouth disease of cattle, not till 1898.

In spite of serious scientific study during the past three decades, virus still remains the "mysterious particle", defying a positive definition. The best negative definition to the present

day seems to be the following suggested by Lwoff: "Viruses are infectious, potentially pathogenic nucleoprotein entities, with only one type of nucleic acid, which reproduce from their genetic material, *are unable to grow and divide*, and are devoid of enzymes". As yet we have no definite knowledge of the exact manner in which the virus particle enters a cell and undergoes replication. But, thanks to the discovery of the electron microscope, the once vague picture of the relationship of virus with living cells, particularly with the nucleic acids, is becoming more and more clear.

In this book Dr. Kenneth M. Smith, formerly Director, A.R.C. Virus Research Unit, Cambridge, presents, in a manner that can be understood even by laymen interested in viruses, and at the same time without sacrificing scientific precision, a neat survey of our present state of knowledge, both in theory and in the technique of study, of viruses, of the control of virus disease, and of the uses of viruses as agents in the control of destructive insects. The sixteen pages of plates showing electron micrographs of viruses, some in their biological environment, add value to the book.

The special Paper cover edition of the book priced at a lower level should enable all interested in viruses and virology to own a copy.

A. S. G.

**The Chemistry of Lignin—Supplement Volume, covering the literature for the years 1949-1958.** By F. E. Brauns and D. A. Brauns. (Academic Press, New York; India: Asia Publishing House, Bombay-1), 1960. Pp. x + 804. Price \$ 18.00.

This is a supplement to the earlier volume by F. E. Brauns on the "Chemistry of Lignins". The additional feature of the present volume is the extensive coverage of the Japanese and Russian literature on lignins.

This book comprises of 26 chapters dealing with various aspects of lignin chemistry including its physical properties, thermal and biological decomposition, theories on lignin structure, its linkage in the plant and biosynthesis. There is also a chapter on synthetic lignins. There is a useful appendix of commercial lignins and utilization of lignin. The book is profusely illustrated with graphs, tables, and formulas. It is unlikely that many individual chemists might like to own a copy of this book but it certainly should have a place in any technical library and in the specialists' book-shelf.

S. K. BALASUBRAMANIAN,

**Modern Documentation and Information Practices.** Edited by O. Frank. (Published with the assistance of UNESCO by the International Federation for Documentation, 7, Hofweg, The Hague), 1961. Pp. x + 225.

This is a composite manual of 14 chapters contributed by five persons—all drawn from Europe only. It is somewhat disappointing to note that in a list of "Recommended books and articles" numbering no less than 210 entries, there are only two articles by two Asian authors and that too because they appeared in European organs. This is a measure of the insularity still prevailing among the documentalists of Europe, in spite of Dr. King, the former President of the FID, having been insisting for years that the FID is not a purely European concern.

Turning to the merits of the book, it is encyclopedic in coverage. There are three chapters on organisation of documentation centres in public and private sectors including their co-ordination and co-operation. Two chapters are turned on the internal organisation and administrative routine of a documentation centre. There are three chapters on the technique of classification, cataloguing, and abstracting, making up documentation work.

One chapter is devoted to the problem of the translation of documents. Three chapters are on the technician's work involved in mechanical retrieval of information and the photo and the chemical methods of production of copies of documents. There is one chapter on the training of documentalists, filled with many copy-book maxims.

It is an irony that this compendious book by the FID should have been produced without an index—the traditional aid to the retrieval of the information scattered within the book and some in unexpected places.

The physical production of the book has been done in a good and pleasing style.

S. R. RANGANATHAN.

#### Books Received

**Practical Plane and Solid Geometry.** By A. Shariff. (Asia Publishing House, Bombay-1), 1962. Pp. xi + 334. Price Rs. 12.00.

**Elements of Tropical Soil Science.** By T. Eden. (Macmillan & Co., London), 1962. Pp. vii + 136. Price 2 sh. 6 d.

**Pure and Applied Physics (Vol. 13) Atomic and Molecular Processes.** Edited by D. R. Bates. (Academic Press, New York 3), 1962. Pp. xv + 904. Price \$19.00.

**Principles of Stratigraphy.** By A. W. Grabau. (Dover Publications, New York 14), 1961. Vol. I: Pp. xxxiv + 581. Price \$2.50; Vol. II: Pp. 583-1185. Price \$2.50.

**Treatise on Sedimentation.** By W. H. Twenhofel. (Dover Publications, New York 14), 1961. Vol. I: Pp. xix + 460. Price \$2.35; Vol. II: Pp. xii + 461-926. Price \$2.35.

**Logic, Methodology and Philosophy of Science.** Edited by E. Nagel, P. Suppes and A. Tarski. (Stanford University Press, Stanford, California), 1962. Pp. ix + 649. Price \$12.50.

**Absorption Spectra and Chemical Bonding in Complexes.** By C. K. Jorgensen. (Addison-Wesley Pub., Reading, Mass., U.S.A.), 1962. Pp. xii + 352. Price \$10.00.

**Elements of Chemical Thermodynamics.** By L. K. Nash. (Addison-Wesley Pub., Reading, Mass., U.S.A.), 1962. Pp. vii + 118. Price \$1.75.

**Annual Review of Biochemistry (Vol. 31).** (Annual Reviews, Inc., Palo Alto, California, U.S.A.), 1962. Pp. vii + 731. Price \$7.00.

**Botanical Monograph No. 2—Marsilea.** By K. M. Gupta. (Council of Scientific and Industrial Research, New Delhi), 1962. Pp. vi + 113. Price Rs. 16.00.

**Barley and Malt—Biology, Biochemistry and Technology.** By A. H. Cook. (Academic Press, New York), 1962. Pp. ix + 740. Price £7/10 sh.

**Micrographia.** By R. Hooke. (Dover Publications, New York 14), 1961. Pp. x + 272. Price \$2.00.

**Introduction to Electron Microscopy.** By S. Wischnitzer. (Pergamon Press, Oxford), 1962. Pp. xi + 132. Price 42 sh.

**Advances in Inorganic Chemistry and Radiochemistry (Vol. 4).** By H. J. Emeleus and A. G. Sharpe. (Academic Press, New York 3), 1962. Pp. viii + 344. Price \$11.00.

**British Medical Bulletin—Electron Microscopy**—Vol. 18, No. 3, September 1962. (Medical Department, The British Council, 65 Davies Street, London W. 1), Pp. 179-254. Price 35 sh.

**Theoretical Electro-Magnetism.** By R. H. Atkin. (William Heinemann, 15-16 Queen Street, London W. 1), 1962. Pp. vii + 260. Price 30 sh.

## SCIENCE NOTES AND NEWS

### Award of Research Degree

The Annamalai University has awarded the Ph.D. Degree in Chemistry to Shri P. Subbarayan for his thesis entitled "Dipole moments and absorption spectra of some organophosphorous and organomercury compounds".

The University of Baroda has awarded the Ph.D. Degree in Chemistry to Shri K. N. Trivedi for his thesis entitled, "Studies in Benzo-a-Pyrones".

### Conference of Hydraulics and Fluid Mechanics

According to the tentative programme drawn up for the above Conference, to be held at the University of Western Australia, 6th to 13th December 1962, there will be about sixty papers ranging over the fields of hydrodynamics, hydraulic and mathematical models, open channel flow including sediment transport, hydrology, measuring instruments and hydraulic machinery.

Professor Hunter Rouse of the Iowa Institute of Hydraulic Research, U.S.A., has accepted an invitation to deliver the Inaugural Address.

Readers who have not already received the 3rd Circular, which contains the Programme, and are interested to attend should apply to the Convener, Dr. R. Silvester, Department of Civil Engineering, the University of Western Australia, for the circular and registration form.

### Pirbal Sahni Institute of Palaeobotany, Lucknow

The fifteenth annual scientific meeting of the Palaeobotanical Society will be held at the Institute's premises on the 21st and 22nd January 1963. Many palaeobotanists are expected to participate, and the programme will include lectures, presentation of papers, discussions, etc.

### Central Institute for Communicable Diseases

The Government of India have decided to expand the activities of the 53-year-old Malaria Institute of India, Delhi, and to make it a centre for studies on various problems connected with communicable diseases. The Institute (22 Alipore Road, Delhi-6) has been renamed as the Central Institute for Communicable Diseases with effect from August 21, 1962.

The objectives and functions of the Central Institute for Communicable Diseases will be to advise Government on all matters relating to communicable diseases and initiate investigations

in these diseases. Arrangements will be made at the Institute for training research workers and teaching and training personnel in epidemiology, medical entomology and control of communicable diseases.

### *Torulopsis utilis*—A Salt-Acid Tolerant Yeast from Mango

Messrs. B. A. S. Rao and J. S. Pruthi, Division of Fruit Technology, Central Food Technological Research Institute, Mysore-2, write :

Fully developed green mangoes of a pickling variety were peeled, destoned, sliced and were dry-salted (for curing purposes) at various levels ranging from 5 to 18% (w/w) and were also brined separately at levels ranging from 10 to 25%. After a week, a white film was noticed in all the samples except in the 18% salted one. Based on systematic morphological and physiological studies, the spoilage organism (yeast) was identified as *Torulopsis utilis*. The salt and acid tolerance of the isolate were determined by inoculating the organism into malt-yeast extract broth containing different concentrations of (a) common salt ranging from 15 to 24% and (b) citric acid ranging from 4.0 to 7.0% (pH 2.7 to 2.5) respectively. The growth was confirmed by plating out the broth, using P.D.A. salt medium. It was found that the strain could tolerate 17% salt concentration and 6.0% citric acid (pH 2.5). Thus, a minimum concentration of about 18% common salt is suggested for the preservation of mango slices in brine.

### Occurrence of a Neotylenchid on a Lepidopterous Larva

Sri. H. David, Indian Institute of Sugarcane Research, Outpost, Koothanallur, Tanjore, writes :

A nematode was recently recorded from a caterpillar of sugarcane top borer, *Scirpophaga nivella* F., at Koothanallur in Tanjore district of Madras.

The caterpillar, which was fully grown and had already formed the "exit hole", was found dead within its tunnel (in the cane stalk) when the cane was split open. It was kept under observation in a glass tube to ascertain the cause of its premature death. On the 6th day, a large number of eelworms were found emerging from the body of the dead caterpillar.

These eelworms were later identified by Dr. Welch of Canada as belonging to *Neotylenchus* sp. According to Dr. Welch, this is probably the first record of occurrence of a Neotylenchid on a Lepidopterous larva.

#### Occurrence of *Gibberella fujikuroi* (Saw.) WR. on Corn in Bihar

Dr. A. P. Misra, Department of Plant Pathology, Bihar Agricultural College, Sabour, reports the occurrence of the perithecia of *Gibberella fujikuroi* on the basal stalks of wilted corn plants in experimental plots at Sabour. The perithecia were borne in pinkish cushions, clustered together, ovoid in shape, ostiolate,  $320 \times 422 \mu$  in diameter. The asci were  $41.6-47.8 \mu$  long and  $6.2-8.3 \mu$  broad. The ascospores, eight in number, were straight, ellipsoid, paleochraceous, *samon en masse*,  $12.5-16.6$  and  $4.16-6.24 \mu$ , rounded at tips, short, thick and 1-septate.

This appears to be the first record of the perithecial stage of the fungus on corn in India. The fungus seems to cause wilting of corn plants at the time of silk or grain formation.

#### Record of *Habenaria viridiflora* (Sw.) R. Br. var. *dalzellii* Hook. f. from Assam

Shri S. K. Katagi, Botanical Survey of India, Eastern Circle, Shillong, records for the first time the occurrence of *Habenaria viridiflora* (Sw.) R. Br. var. *dalzellii* Hook. f. for Eastern India from Maumloo (*H. Deka*) and Umsaw (N. Rao 25096) of Khasi and Jaintia Hills of Assam.

*Distribution*: Konkan, Malwan.

#### A New Record for *Botrychium* from Pachmarhi (M.P.)

Messrs. R. M. Patel, R. P. Shah (P.M.B. Gujarati Science College, Indore, M.P.) and S. S. Moghe (College of Science, Raipur) report the finding of the rare fern *Botrychium virginianum* (L.) Sw. var. *lanuginosum* from Pachmarhi, M.P.

The plant is a small perennial herb growing on the sandy loam, near a stream and attaining a height of  $2-2\frac{1}{2}$  ft. Branches and leaves are hairy, pinnules cut down almost to the rachis into linear-oblong segments. The fertile branch springing from the middle of the stipe is between 16 and 18" long and sporangiferous spike is more prominent. Intensive search for these plants in different seasons extending for the period of three years, 1959-62, has revealed that the area of distribution is very much restricted.

So far it has been found only at one place namely at the picnic spot Pathar chatta.

#### Germination of Pollen Grains of *Hibiscus esculentus* L.

Shri A. Prasad, Department of Horticulture, Government Agricultural College, Kanpur, observed not appropriate setting of fruits in the course of hybridizing trials of *Hibiscus esculentus* L. varieties Pusa Makhmal and a local one under Kanpur conditions. With a view to determine the best culture media of sucrose solution to test the pollen grain germinability, experiments were carried out during September 1961. The maximum percentage of germination and tube growth were found in 25% sucrose media. Higher concentrations had adverse effect.

#### International Indian Ocean Expedition

India is to participate in the International Indian Ocean Expedition, the first systematic scientific attempt to study the Indian Ocean. This international project will continue up to 1964. Forty ships equipped with scientific instruments belonging to about 20 countries will take part in the Expedition.

Four vessels, one of which will be a frigate of the Indian Navy, will participate in the Expedition. Another major vessel, which is already making exploratory cruises, is R. V. *Varuna* of the Indo-Norwegian Project, now doing fishery research cruises between Cochin and Mangalore.

Although the Indian Ocean's 28,000,000 square miles cover over 14% of the earth's surface, little is known about the region. The Indian Ocean has several unique characteristics. Nowhere else in the world is there a similar seasonal reversal of the prevailing wind. The wind system in the part of the Ocean lying about the Equator is characterised by the two monsoons. Another notable feature is the apparent productivity of the Ocean. The problems to be studied concern physical and chemical oceanography, meteorology, marine biology and marine geology and geophysics.

Dr. N. K. Panikkar, till recently Fisheries Development Adviser to the Government of India, is Director of the Indian team.—(Press Information Bureau, Government of India.)

#### New Calcium Fluoride 'Laser' for Infra-Red Light

Many new materials are coming into prominence as active elements in solid state optical masers. Such materials as calcium fluoride doped with uranium or samarium,

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barium fluoride doped with uranium, and calcium tungstate doped with neodymium, are a few which have received considerable attention and show some promise of supplementing ruby.

The Radio Corporation of America have announced the development of a new "laser" to generate powerful beams of infra-red light. Lasers are devices that amplify light waves and emit them "in step" to form a highly directional and powerful beam of coherent light, in contrast to the incoherent, or random nature of light waves emitted from conventional sources. The name Laser is derived from the term "Light Amplification through the Stimulated Emission of Radiation".

The new RCA device is built around a calcium fluoride crystal containing traces of the rare-earth element dysprosium, and is distinguished from other reported materials by the comparatively low power (about 10 times less) required to make it emit light. Moreover, such emission is triggered by a very broad band of light energies stretching across the visible spectrum from infra-red to ultra-violet.

Because of this, it should be possible to achieve continuous output of infra-red emission from the new material by using mercury and possibly even tungsten lamps to activate it. By contrast, most solid state lasers currently give a pulsed output and require the intense power of a xenon flash lamp to operate.

In the new laser, this amplification is achieved by shining ordinary light, consisting of many different frequencies, upon a calcium fluoride crystal some of whose electrons are thereby stimulated to emit light at only one of those frequencies. By silvering both ends of the crystal, one partially and one completely, most emitted light is made to reflect back and forth through the crystal inducing still other electrons to emit. The effect is cumulative until the coherent energy radiating from the partially silvered end is more intensive than light at the surface of the sun. The new laser is expected to have great value in studies of coherent light beams for use in missile defence, communications, and metallurgy.—(*J. Frank. Inst.*, 1962, 274, 71.)

### New Light on RNA Structure

Although DNA and RNA both consist of the subunits called nucleotides, their roles in the living cell are quite different. DNA is the hereditary material—the genes. RNA has two well-established functions. 'Messenger' RNA

carries information from DNA to the cellular particles called ribosomes, instructing them how to synthesise proteins. 'Transfer' RNA comes in 20-odd varieties specifically coded to recognize each of the 20-odd amino-acids that are assembled into proteins. Transfer RNA delivers amino-acids as needed to the ribosomes.

Spencer *et al.* have reported in *Nature* the results of their recent investigations on the structure of RNA. They focussed their efforts on transfer RNA because its molecular chain contains only about 80 nucleotide subunits. It is therefore considerably smaller than messenger RNA and easier to purify.

They found that when transfer RNA from baker's yeast was obtained in crystalline form, it produced clear X-ray diffraction pictures in which previous ambiguities could be resolved. They concluded that the polynucleotide chain of RNA is folded double and twisted into a helix. The helix is about 100 angstroms long and is twisted around its long axis about  $3\frac{1}{2}$  times. As in DNA the two chains of the helix are cross-linked by pairs of subunits called bases. In RNA these pairs are adenine linked to uracil, and guanine linked to cytosine. Because of this base pairing, transfer RNA should contain equal numbers of adenine and uracil units, and of guanine and cytosine units. The equivalence has been confirmed by base analysis.

The distinctive feature of the RNA molecule is the fold, or junction, at one end which consists of at least three unpaired nucleotides. These three units may specify a particular amino-acid, matching the code for amino-acid sequence dictated by messenger RNA. The function of the remaining nucleotides may be to react with a specific amino-acid-activating enzyme so that the correct amino-acid is picked up by the transfer RNA. The British group has evidence that extensive helical regions exist in all other forms of RNA.—(*Sci. Amer.*, 1962, 207, 53.)

### Two Neutrinos

A massive experimental effort, almost two years in the planning and execution, has demonstrated that two distinct kinds of neutrino exist. One of them is connected in some way with the electron; the other, apparently in the same way, with the muon (or mu meson). The experiment was performed with the 30 Bev. accelerator at the Brookhaven National Laboratory.

The neutrino is a massless neutral particle that was proposed about 30 years ago to explain an apparent discrepancy observed in  $\beta$ -decay.

It was found that the energy of the emitted electron from a radioactive nucleus in the process of  $\beta$ -decay was slightly less than the energy lost by the nucleus itself. It was proposed that along with the emission of the electron there was also the emission of a neutrino which carried this excess energy. The  $\beta$ -decay neutrino was directly detected only in 1955.

Meanwhile in studying the decay of pi-meson (pion), another energy discrepancy was noticed. As in the case of the  $\beta$ -decay, the conversion of pion into muon was accompanied by a loss of energy and by analogy it was attributed to a "neutrino". However, there was no reason why a neutrino created with a muon should be the same as the neutrino created with an electron. There was always a suspicion that a muon neutrino was different from an electron neutrino.

With the successful completion of the 30 Bev. accelerator at Brookhaven and at CERN, there arose the possibility of putting the question to test, as these accelerators could furnish neutrinos with enough energy to make an experiment possible.

The experiment consisted in allowing a pure beam of muon-connected neutrinos to interact with nuclei in a target material and to examine the products of all the reactions. If all neutrinos are the same, then their interactions should produce electrons and muons impartially. If they are not the same, the muon-connected neutrinos should make only muons.

The target consisted of 10 tons of aluminium in the form of inch-thick, four-foot square plates in a "spark chamber". A high voltage between successive plates caused a spark trail whenever a muon or an electron passed through the chamber. Muon trails look different from electron trails.

To obtain the beam of test neutrinos the proton beam of the accelerator was directed against a beryllium target producing a beam of pions. They were allowed to decay into muons and neutrinos over a 60-ft. path. Then the muons and the undecayed pions were filtered out through 42 feet of solid iron. The neutrinos which passed through the iron continued into the spark chamber, where they

were observed for tracks of the extremely infrequent reactions looked for.

In 700 hours of actual running time over the past six months 50 mu-type neutrinos were caught, out of an estimated 100 trillion that passed through the 10-ton detector. In 29 reactions a single energetic muon was produced; in the other 21 reactions muons were produced together with other particles. There were no energetic electrons. Therefore the muon-connected neutrino is intrinsically different from the electron-connected neutrino.—(*Scientific American*, 1962, 207, 52.)

### Structure of Cyclobutane from Rotational Raman Spectra

In the programme of research on high resolution Raman spectroscopy of gases at the National Research Council, Ottawa, Canada, a series of papers have been published. The fifteenth paper in the series by B. P. Stoicheff and R. C. Lord reports on the structural information obtained from the rotational Raman spectra of normal and fully deuterated cyclobutane ( $C_4H_8$  and  $C_4D_8$ ).

Although the equilibrium symmetry of the cyclobutane molecule has not yet been established and may be either  $D_{4h}$  (planar  $C_4$  ring) or  $D_{2d}$  (puckered  $C_4$  ring), it has been possible to determine some of its structural parameters experimentally. The rotational structure analysis of the Raman spectra of  $C_4H_8$  and  $C_4D_8$ , photographed in the second order of the N.R.C. 21 ft. grating spectrograph, leads to the moments of inertia of the molecule as  $(78.887 \pm 0.05) \times 10^{-40}$  g. cm.<sup>2</sup> for  $C_4H_8$  and  $(109.354 \pm 0.08) \times 10^{-40}$  g. cm.<sup>2</sup> for  $C_4D_8$ . From these, the C—C bond length has been evaluated as  $1.558 \pm 0.003$  Å, irrespective of whether the molecule belongs to the group  $D_{4h}$  or  $D_{2d}$ . This value is in reasonable agreement with that determined by electron diffraction method, namely,  $1.56_s \pm 0.02$  Å.

In principle, the molecular symmetry of cyclobutane could be determined from the intensity distribution of its rotational Raman spectrum. However, because of the very low intrinsic intensity of the Raman spectrum of cyclobutane it was not possible to ascertain this although the observation appeared to favour the  $D_2$  symmetry.—(*Canad. J. Phys.*, 1962, 40, 725.)

## THE TWO SPECIES OF FLUORITE

SIR C. V. RAMAN

AMONGST the many interesting properties of the mineral fluorspar or fluorite is the luminescence which it exhibits under ultra-violet illumination. In many cases and especially with the larger specimens, the effect observed is indeed spectacular. The nature and origin of the phenomenon are thus problems of great scientific interest. In an earlier article (*Current Science*, September 1962, pp. 361-65) the present author gave a preliminary account of his investigations in this field. One of the significant discoveries recorded in that article is that when fluorite is cooled down to the temperature of liquid air, the spectrum of its

behaviour to be entirely characteristic of fluorspar. The emission located at  $4132 \text{ \AA}$  appears at the same position in all cases, irrespective of the place of origin of the mineral or the absolute intensity of its luminescence which indeed in some cases is enormously greater than in others.

The observations reported in the earlier article were made with naturally occurring fluorite specimens. It seemed to be of great importance to carry out similar studies with synthetically prepared fluorite of optical quality which is now commercially available. This

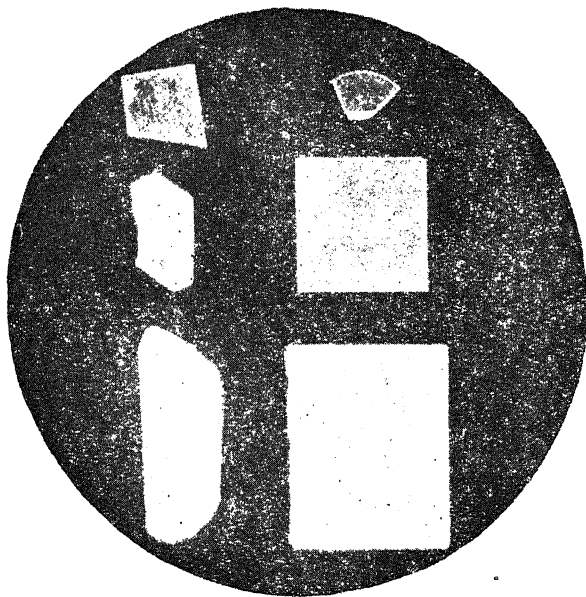


FIG. 1. Six specimens of fluorite under ultra-violet illumination.)

luminescence undergoes a remarkable transformation. The diffuse band stretching from the violet end into the blue region of the spectrum seen at ordinary temperature is replaced by a sharply defined emission line or band centred at  $4132 \text{ \AA}$  of which the spectral width is only a few Angstroms. This is accompanied by various subsidiary features which are noticeable in the part of the spectrum at greater wavelengths. Further studies have shown this

material, as is well known, is prepared from carefully purified  $\text{CaF}_2$  by fusion and slow solidification. It is perfectly colourless and isotropic and its transparency extends into the far ultra-violet. Three specimens of such fluorite were available for the studies. One of them was a rectangular block  $37 \text{ mm.} \times 37 \text{ mm.}$  in area by 9 millimetres thick which was supplied by a well-known British firm. A piece 6 millimetres wide was sawn off from the

block and employed for the study of the infra-red absorption spectra of plates of fluorite of various thicknesses. The results of this study will be reported in a separate communication. The second specimen was a polished window of synthetic fluorite 25 mm.  $\times$  25 mm. in area and 2 millimetres thick which was gifted to the author by Dr. E. K. Plyler of the National Bureau of Standards at Washington. A third specimen was a smaller plate 1.7 millimetres thick which was sent by Professor R. Mecke from his Institute at Freiburg. The infra-red transmission by the two plates was spectrophotometrically studied and did not exhibit any noticeable differences as between themselves. The infra-red behaviour of the British specimen studied with thicknesses of 2 millimetres and one millimetre respectively was also similar to those of American and German manufacture.

British origin respectively. The three specimens seen on the left of the picture are pieces of natural fluorite whose thicknesses were about the same as that of the synthetic specimens set alongside of them and seen on the right-hand side of the photograph. It will be noticed that the two specimens (one natural and the other synthetic) at the top of the picture are non-luminescent. The two other pairs of specimens, on the other hand, exhibit a readily observable luminescence, of which the intensity is noticeably greater in the case of the natural fluorite.

It should be mentioned here that the spectrum of the luminescence of the synthetic fluorite supplied by the British firm has been studied with the material held at liquid air temperature. A very satisfactory spectrum has been recorded

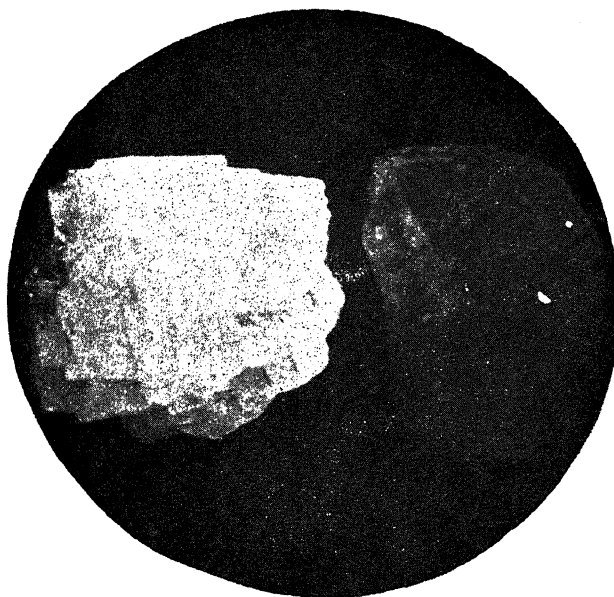


FIG. 2. Luminescent and non-luminescent fluorspar.

Figure 1 is a photograph of six specimens of fluorite as seen under intense ultra-violet illumination. They were placed on a sheet of black paper and an appropriately chosen filter was placed before the lens of the camera to cut off the ultra-violet radiation scattered by the black paper or reflected at the surfaces of the specimens. The three specimens seen on the right-hand side of the picture are the synthetic crystals of German, American and

with it, exhibiting the well-defined feature at 4132 Å accompanied by other details in the region of greater wavelengths. Figure 1 may in the circumstances be regarded as a demonstration of two results of fundamental importance. In the first place, it is clear that luminescence is a characteristic property of fluorite. Secondly, there are two species of fluorite, (either natural or synthetic), of which one exhibits luminescence and the other does not. The difference between



the two species is not a difference in degree, but an absolute difference in the sense of luminescence being either present or being totally absent. The total absence of luminescence in one species and its visible presence in the other specimens becomes most clearly evident when the specimens of the two species are set side by side under ultra-violet illumination of the greatest obtainable intensity and against the darkest possible background and are compared visually. Such a comparison made photographically instead of visually is exhibited in Fig. 2. The specimen of fluorspar on the left is one of the numerous examples of the mineral finding a place in the museum of the Raman Research Institute. It is a block

Why one species of fluorite exhibits luminescence and the other does not is a problem in itself. Much useful light is thrown on this question by the author's studies of the material from the newly discovered deposit of fluorite at Amba Dongar near Chota Udaipur in the Baroda District. Through the kindness of the officers of the Geological Survey of India, a considerable quantity of this material has been made available to the author for his studies. Much of it is in the form of fairly thick blocks which are close aggregates of cubic crystals. The crystal forms are visible on one external face of each block, while the other face shows evidence of the mother rock from which the fluorspar crystallised.

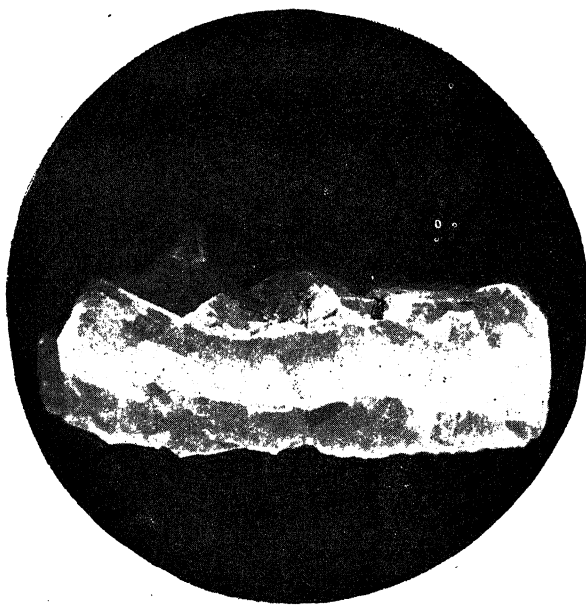


FIG. 3. Luminescent layer in Amba Dongar fluorite.

of colourless fluorite which is an aggregate of cubic crystals, and was selected for the comparison by reason of the fact that the luminescence which it exhibits is of extremely low intensity. The specimen on the right is a large transparent single crystal in the shape of a cubo-octahedron with well-defined faces. Under the ultra-violet lamp, it is scarcely visible. Indeed it is only seen in the photograph by reason of the reflection at its faces of the illumination from the neighbouring luminescent sample.

Placing a block under the ultra-violet lamp, it is immediately evident that the material is not all of the luminescent variety. This becomes most clearly evident when the edge of the block is viewed under ultra-violet illumination. The feature then noticed is that a layer of luminescent material which is more or less exactly parallel to the external faces of the block is sandwiched between two layers of non-luminescent fluorspar, while the external face of the block showing the individual crystals usually exhibits an observable luminescence.

The former feature is illustrated in Fig. 3 which shows *the edge of one block*, the upper face of the block seen in profile being only dimly visible in the picture. The luminescent layer is clearly seen in the photograph, while the non-luminescent layers on either side of it are only seen by reason of the light from the luminescent layer which penetrates both above and below and is reflected or scattered within those layers. It should be mentioned that the luminescent layer can easily be distinguished in ordinary daylight from the non-luminescent ones above and below it, by reason of its being clearer and more transparent.

most cases did not extend over the whole volume of the fragment. The reason for this becomes clear when such pieces were shaped by grinding and polishing into flat plates with optically good faces. A collection of such plates as photographed under ultra-violet illumination is illustrated in Fig. 4. The luminescent and non-luminescent areas appear side by side in the same individual crystal, the surfaces of separation being nearly always sharply defined planes.

The facts of observation set forth above indicate that whether fluorspar exhibits luminescence or does not is determined by the ultimate structure or texture of the crystal which is

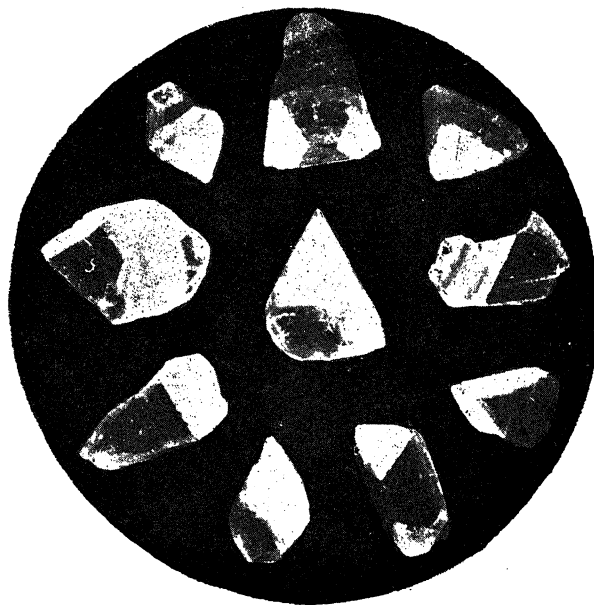


FIG. 4. Single crystals of fluorite exhibiting luminescent and non-luminescent sections.

A considerable part of the Amba Dongar fluorite as it came into the hands of the author consisted of small individual fragments and individual crystals which had evidently broken off from the bulk of the mineral during its excavation from the site. Many of the fragments were found to be totally non-luminescent, while others showed luminescence which in

determined by the temperature and other conditions under which the crystallisation took place. That the difference in the two species arises from the presence or absence of extraneous impurities is a hypothesis which can be scarcely regarded as tenable in the light of the overwhelming factual evidence to the contrary.

## DESIGN SPECIFICATIONS FOR OPTICAL LASER RUBY RODS

NELSON B. PIPER, JR.

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WHEN specifying the design of solid-state configurations, such as ruby rods, to be used as the active elements in optical masers, a number of considerations are involved, all of which reflect directly on the present state of the art in crystal growing techniques and the skills and facilities available for precision fabrication.

Much of the effort expended over the past two years in the field of optical masers has been directed toward the development of better materials and new configurations of finished ruby laser rods. Also, improved means of material selection and measurement of the mechanical and optical parameters have received considerable attention.

It is expected that over the next few months many new and improved materials will be made available to the design engineer and scientist for performing experiments that will eventually lead to continuous wave operation, increased efficiency, higher output power levels, improved beam angle characteristics, narrower band width and a more coherent light beam.

With the increased availability of more solid-state laser materials, it is necessary that the designer knows to what practical limits the important mechanical parameters of a laser rod can be controlled by the precision fabricator.

Because of strains produced in growing raw crystals—lineage (deviation of the crystals' axis) and dislocations which are present to varying degrees in most laser crystals—the state of the art in precision fabrication is somewhat further advanced than present crystal growth techniques. This gives the designer an opportunity to specify tolerances which will allow him to study various host materials and doping elements knowing that variations in fabrication tolerances will not (within certain limits) affect to any great extent the operation of the optical maser. It is important, however, that these minimum limits in fabrication tolerances be observed, otherwise the effects of fabrication variations will become quite prominent.

Because of variations in raw material quality, as in synthetic ruby, it is possible to obtain finished laser rods from the precision fabricator made from material which has been optically inspected and graded for quality. Specifying "selected materials" in this manner does result in cost increases over normal prices for "non-

selected material". However, it offers the scientist who has completed his preliminary investigations an opportunity to perform more sophisticated experiments using the same basic raw material but of superior quality.

Values for threshold level, beam divergence, reflectivity of end coatings and other parameters pertaining to the operation of the finished laser rod can also be supplied with the rod by the precision fabricator, at nominal cost. Such a material and operating characteristics analysis is also available to the scientist who already has materials and/or finished laser rods he wishes to have inspected.

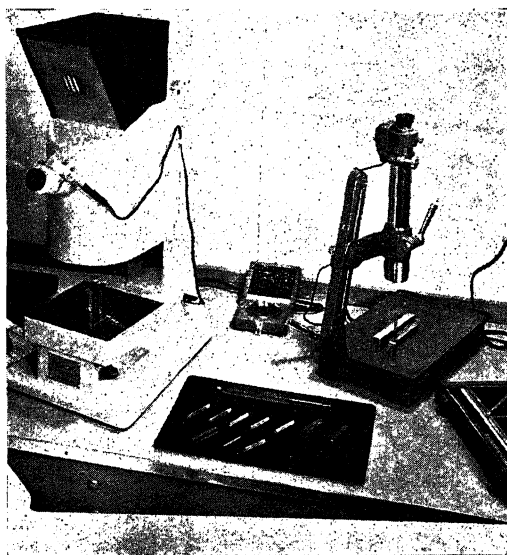


FIG. 1. Interference fringes on the optical-interferometer screen check the end faces of a ruby rod for flatness within  $1/20$  of a sodium wavelength. Instrument at right checks parallelism of end faces to within 1 second of arc. On table are ruby rods and three rough cuts from ruby disc boules.

Data taken from recent measurements of ruby laser rods fabricated from "non-selected material" and having controlled deviations in flatness and parallelism of the end faces indicated that a flatness poorer than  $1/10$  wavelength (reference sodium light) had considerable effect on the laser beam spread, and parallelism poorer than 2 seconds of arc directly

affected the amount of threshold energy required to stimulate laser action.

The accuracy of a standard optical interferometer allows flatness measurements to 1/20 wavelength (sodium light) by comparing the surface of a known standard with the surface under test. The pattern which is observed is similar to that seen on a contour map, the flatness of the surface in question being determined by the straightness of the interference fringes or lines.

An autocollimator—to measure parallelism—is essentially a telescope having an internal brightly illuminated scale which is projected, via a highly collimated light beam, simultaneously onto both polished end faces of the laser rod under test. The relative positions of the two reflected images of the scale, as viewed in the telescope, indicates the relative angular position of the surfaces under test.

Tolerances on the length and diameter of most laser rods having flat and parallel ends are not extremely critical and are usually determined by the variations in the mechanical assembly designed to hold the rod. Practical limits for the fabricator, however, are  $\pm .001$ " on the diameter and  $\pm .005$ " on the length of the rod.

Although the ends of the rod may be parallel and flat, it is important that the ends of the rod are also directly opposite each other (a right cylinder), otherwise a part of the useful reflected light (that which is travelling perpendicular to the end faces) will lose its effectiveness. As a result there will be a decrease in efficiency and increased beam divergence. The 90° angles between the end faces of the rod and the cylindrical surface can readily be held within  $\pm 1$  minute of arc thus insuring a nearly perfect right cylinder.

Concerning orientation of the ruby rod with respect to one of its crystallographic axis, one of the more accurate approaches is to measure the deviation of the crystal axis through the ruby blank using X-ray diffraction techniques, and then grind the cylindrical surface of the rod parallel or perpendicular to the specified axis. By X-ray diffraction techniques it is possible to measure the deviation of the crystal axis within  $\pm 10$  minutes of arc.

The end faces of a laser rod having flat and parallel ends, and the reflecting surfaces of rods fabricated into special configurations, should be polished to the finest optical finish, free from digs and scratches so as to provide an exceptionally good transmitting and/or reflecting surface.

The cylindrical surface of a laser rod can be supplied with either a fine ground or clear polished finish.

A clear polished finish on this surface will result in a somewhat lower relative threshold value but will increase the activity of spurious modes due to internal reflection by the highly polished walls. Spurious modes decrease the available population density and reduce the overall efficiency. A rod having a fine ground cylindrical surface will require a relatively higher amount of input energy to exhibit laser action but will also offer improved efficiency due to absorption rather than reflection of light energy not travelling parallel to the axis of the rod.

When specifying the purchase of a laser rod, every detail must be covered to insure optimum operating characteristics. It is not enough to state merely that the rod exhibit laser action.

Of all solid-state laser materials which have been so far developed, the versatility, ease of fabrication and performance of ruby (chromium doped sapphire) has made it the most prominent. Two ruby rod sizes available from stock from most suppliers are  $2\frac{1}{2}$ " in length by  $\frac{1}{4}$ " in diameter and 2" in length by  $\frac{1}{4}$ " in diameter, doped with 0.05% weight  $\text{Cr}_2\text{O}_3 : \text{Al}_2\text{O}_3$ , 0° oriented (C-axis of the crystal parallel to the rod axis), and fabricated from "non-selected" material.

Most laser rods fabricated to date have been under 3" in length and  $\frac{3}{8}$ " in diameter. This size range is compatible with the power of most optical pumps which are readily available and allows greatest flexibility for basic research in various materials and rod configurations.

A concentration of 0.05% :  $\text{Cr}_2\text{O}_3$  appears to be optimum for ruby in most applications. Heavier concentrations of chromium have yielded laser action at wavelengths other than 6943 Å which is commonly associated with 0.05% ruby. Chromium concentrations both heavier and lighter than 0.05% may require more power to stimulate laser action or may show no laser action whatsoever. Studies are being made to more clearly determine the effects of doping on the operation of the ruby laser rod.

A 0°-oriented ruby will display an elliptically or circularly polarized beam. A ruby laser rod fabricated such that the C-axis is perpendicular to the rod axis (90° orientation) will display a beam that is polarized in one direction.

When comparing the threshold level vs. temperature characteristics of 0° and 90° oriented ruby, it has been determined that the 0° rod has a much steeper slope. As a result the 90° rod is a better choice for room

temperature operation and the 0° rod a better choice for operation at liquid helium temperatures. This choice would be made if one desires to realize the maximum number of laser actions per unit time.

with inputs of only 35 to 50 joules. The sapphire overlay is a sheath which encircles the body of the ruby rod over its entire length.

The sapphire overlay helps focus the pumping light so that its intensity is increased in the

TABLE I

Solid-state Optical Maser Materials						
Crystal		Dopant	Output Wavelength (Å)	Input Wavelength (Å)	Approximate Illumination Threshold (w/cm.*)	Maximum Operating Temperature (K)
Pink Ruby	..	Chromium (0.05%)	6,943	4,000	700	350
				5,500		
Dark Ruby	..	do. (0.50%)	7,030	4,000	300	77
			7,008	5,500		
Calcium Fluoride	..	Uranium (0.05%)	22,000	5,500		
			26,000	8,900	10-50	280
				11,000		
do.	..	Samarium (0.05%)	7,080	6,300	20	40
Barium Fluoride	..	Uranium	22,000	5,500		
			26,000	8,900	10-50	280
				11,000		
Calcium Tungstate	..	Neodymium (0.10%)	10,600	5,800	1	295
do.	..	Praseodymium	10,470	4,500		
				5,000	10	100
				17,500		
do.	..	Thulium	19,100	4,700	60	77
do.	..	Holmium	20,500	4,500	150	77
Strontium Molybdate	..	Neodymium	10,600	5,800	8	280

\* Illumination threshold is expressed in watts of light at the designated input wavelengths per sq. cm. of crystal side-wall area.

Data Courtesy: Bell Telephone Laboratories.

Lower input energy required to stimulate laser action (lower threshold) also minimizes internal heating caused by absorption of excess light energy at frequencies that do not stimulate laser action. A slower rate of internal heating results in a slower rate of threshold rise with time.

There have been many developments in the improvement of ruby\* for laser applications over the past 1½ years. A rod fabricated to 1/10 wavelength flatness and 2 seconds parallelism from "non-selected" material, cut from the most recently developed laser quality ruby, and having dimensions of 2½" in length by ¼" in diameter, will exhibit laser action in the 100 to 200 joules range of input energy at room temperature. (The actual threshold level is also dependent upon the associated optics of the pump.) Some of the original ruby laser rods and light pumps required 2,000 to 3,000 joules of input energy to stimulate laser action.

The sapphire overlay has contributed most to date in lowering the threshold level of ruby, to the extent that laser action has been achieved

central area where the ruby rod is located, thus effectively increasing the capture-cross-section of the ruby rod. The sapphire overlay also effectively increases the conduction cooling area of the composite rod, and being an excellent heat conductor at liquid helium temperatures (nearly 200 times greater than copper) readily dissipates heat developed during operation.

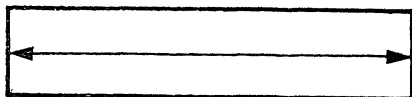
A sapphire overlay can be supplied in two ways. By the first method a build-up of sapphire on the ruby rod (to the desired wall thickness) is accomplished during the crystal growth technique. Such rods are available in lengths up to 1¼" having a ruby diameter of .080" and sapphire overlay diameter up to .200".

The second form of overlay is a sapphire rod, drilled lengthwise and optically polished at the inner diameter. The ruby rod is then optically polished on its outer diameter until a tight piston fit into the sapphire cylinder is obtained. This second form of composite rod can be supplied in lengths from 1¼" to 4".

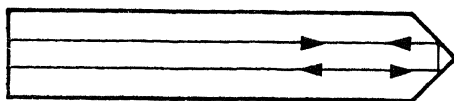
Either of the two sapphire overlay forms can be fabricated into the desired final end configuration.

\* Linde Crystal Products Department, Division of Union Carbide Corporation, East Chicago, Indiana.

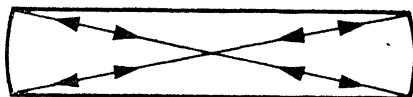
Laser quality ruby up to 3" long by  $\frac{1}{2}$ " in diameter of 0°, 60° and 90° orientation, and up to 8" long by  $\frac{3}{4}$ " in diameter of 60° and 90° orientation, is available to the precision fabricator in the standard 0.05% or special chromium dopings.



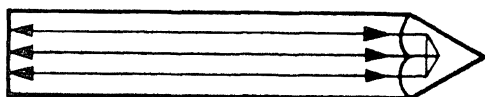
1. *FLAT AND PARALLEL*



2. *ROOF PRISM*



3. *CIRCUMFERICAL*



4. *CORNER CUBE*



5. *CONFOCAL*

Above are the five end configurations presently used in laser rod experimentation. Variations in the output beam characteristics are obtained by altering the internally reflected light. Configurations 1, 2 and 4 all generate a plane wave front. Configurations 2 and 4 utilize a multiple light path to provide increased efficiency and total internal reflection. Configurations 3 and 5 generate spherical wave fronts.

The size of the rod is related to its power-handling capabilities. However, no firm data are available to substantiate an absolute power to size ratio.

In addition to ruby rods having flat and parallel ends, other configurations have been manufactured or suggested. Some of the more common types are those having conical or faceted end configurations which eliminate the

need for reflective coatings since they provide "total internal reflection". Since the reflection is accomplished in many cases by the critical angle at which the light beam strikes the reflecting surface, angle tolerances of  $\pm 10$  seconds of arc or less are in order.

Another configuration which generates a spherical wave-front and offers increased efficiency in operation is the confocal rod which has a convex radius at each end, this radius being equal to the length of the rod. The matching of the radius to the length of the rod is critical and should be held to within at least  $\pm .001$ ". The "parallelism" of the two end faces, however, is not critical. The convex surfaces are optically polished spherical to within  $\frac{1}{4}$  wavelength of sodium light.

A new configuration which has received some attention is the ruby tube having flat and parallel ends. The hole drilled lengthwise down the centre of the ruby rod allows insertion of a light source which, when fired, must transmit all its radiated energy through the ruby surrounding it thus eliminating the possibility of wasted light energy which is common in many other pumping schemes, except perhaps for the elliptical cage with the ruby rod and flash tube at the foci.

Although most of the special configurations which have been manufactured to date (many of which have been proprietary) offer some unique characteristic, none compare with the solid rod having flat and parallel ends for ease of manufacturing in large quantities. Most of the special configurations have to be manufactured singly or in very small quantities.

There are many new materials which are coming into prominence as active elements in solid-state optical masers. In addition to the possibility of doping sapphire with elements other than chromium, there are other crystalline materials already available, doped with various transition elements. Such materials as calcium fluoride doped with uranium or samarium, barium fluoride doped with uranium, and calcium tungstate doped with neodymium, are a few which have received considerable attention and show some promise of supplementing ruby. Also, certain glasses doped with rare earths have been announced that exhibit laser action.

Certainly in the future there will be a large selection of materials to choose from to meet buyers' requirements for output frequency, power-handling capabilities, size, operating temperature and other parameters.

## SPUTNIKS, THE ATMOSPHERE AND ELECTRONS

Y. GALPERIN AND T. MULYARCHIK

**T**HE Northern Lights—the thousand-kilometre long glowing streamers in the upper atmosphere—and variations caused by them in the Earth's magnetic field have long been attracting the attention of scientists. These phenomena, it has been found, depend on solar activity. It has also been determined that they arise hundreds and thousands of kilometres away from the Earth's surface, in a region called the magnetosphere, where the influence of the magnetic field of the Earth is beginning to tell.

The studies of upper atmosphere have also shown that at altitudes, from 100 to 300 kilometres from the Earth's surface, a certain proportion of gas atoms and molecules, that make up the upper layers of the atmosphere, are being continuously ionised, or in other words, are being split into ions and electrons, which form together the ionosphere. During northern lights the process of ionisation is intensified and becomes more chaotic. As a result, the concentration of ions and electrons becomes subject to quick variations, the ionospheric "mirror" which reflects radio-waves loses its homogeneous nature and radio communications are dislocated.

For many years scientists have sought to elucidate the nature of the ionisation process in the upper atmosphere during northern light displays by analysing spectroscopically their glow. These investigations have led to a major conclusion showing that during an Aurora Borealis the upper atmosphere is pierced by streams of electrons with energies ranging from about 1 to 30 kev. The collisions of electrons with the atoms and molecules of the atmosphere cause the latter to ionise and glow. From time to time the atmosphere is also invaded by streams of ionised atoms of hydrogen—protons. Unlike electrons, they enter the denser layers of the atmosphere roughly with the same intensity and simultaneously over large areas. Although such invasions do not result in bright glow, they bring in within a few hours considerable amounts of energy into the atmosphere.

### INTERFEROMETERS

Investigations involving the use of special spectral instruments—interferometers—have demonstrated that at the time of intensive northern lights the temperature at altitudes of 300 to 500 kilometres rapidly rises and reaches 2,000

to 3,000 degrees, whereas the normal temperature there is 800 to 1,200 degrees at night and approximately 1,500 to 2,000 degrees in the daytime. The heated regions of the atmosphere get expanded and the atmospheric density at great heights is increased. There is also a corresponding rise in the resistance which the atmosphere, although a tenuous one, exerts on the motion of artificial satellites. This, too, markedly influences their orbits. The analysis of the orbit motion of artificial satellites has confirmed the conclusion arrived at by terrestrial observers that the temperature in the upper layers of the atmosphere rises not only in the daytime—due to the absorption of solar ultra-violet radiation—but also at night at the time of northern light displays. This means that the total energy absorbed by the atmosphere during Aurora Borealis is very great.

Ground observations made by all available geophysical methods can furnish data only on those processes which occur when this radiation interacts with the upper atmosphere. Primary geoactive corpuscles can be studied only when we go beyond the boundaries of the absorbing atmosphere. The remarkable achievements of rocket engineering have opened up possibilities for a basically different approach to space exploration by geophysics and astronomy—possibilities of making a first-hand study of aerospace with the aid of artificial satellites.

The irregular nature of solar activity—the original cause of these geophysical phenomena and the diversity of forms in which they appear have suggested the development of geophysical sputnik stations with a long life and high informative ability for continued exploration of geoactive corpuscular radiation.

This complicated task has been successfully tackled by Soviet designers, engineers and scientists. Cosmos 3 and Cosmos 5 were placed into orbit around the Earth on April 24 and May 28, 1962 respectively. It is already several months that geoactive molecules are being investigated by them. The long service life of the sputniks enabled measurements to be made both in periods of quiet magnetic field and when there were strong geomagnetic or ionospheric disturbances. Information about solar and geomagnetic activity regularly received from the World Centre for collection of geophysical data by the Institute of Terrestrial

Magnetism, Ionosphere and Wave Propagation of the USSR Academy of Sciences, enables the scientists to predict geomagnetic disturbances and make measurements, by means of sputniks Cosmos 3 and Cosmos 5, choosing periods with different geophysical conditions.

Originally, the distances of Cosmos 3 and Cosmos 5 from the Earth were respectively 229 and 203 kilometres in perigee and 720 and 1,600 kilometres in apogee. But their orbits do not remain constant. As time goes on, perigee and apogee distances are shortened due to the resistance offered by the atmosphere to the motion of the sputnik. An ellipse along which the sputnik is revolving around the Earth's centre, owing to the flattening of the planet at the poles, gradually rotates so that the perigee and apogee points also follow a kind of orbit, completing a full revolution approximately in 100 days.

#### MEASURING DENSITY

With the continued stay of Cosmos 3 and Cosmos 5 in space, it becomes possible to measure with a high degree of accuracy the average density of the upper atmosphere and its variations with time of the day and with latitude at the perigee distance (about 200 kilometres). These data are furnished by the decelerations of the sputniks and also by changes in their periods of revolution about their axes.

The instrumentation carried by Cosmos 3 and Cosmos 5 is intended for the investigation of geoactive corpuscles whose energy is relatively small. Such corpuscles are only capable of penetrating through very insignificant masses of matter, and such radiation is called, therefore, a soft radiation.

Electrons are recorded by means of transducers consisting of a fluorescent screen, which emits light under the action of corpuscular radiation, and a photo-multiplier for measuring the intensity of screen brightness. From outside, the screen is protected with aluminium foil with a thickness of only several microns. Soft radiation could not have penetrated through a thicker barrier. This design of the device ensures high sensitivity with respect to electrons of lower energies and at the same time a low sensitivity to electrons and ions of very great energies and to X-ray radiation. This is very important, because different types of radiation are possible in the upper atmosphere, and instruments must not "confuse" between them. Three instruments are directed parallel to the sputnik's axis of symmetry, one faces the reverse direction, and

one is mounted perpendicular to the sputnik axis.

The first three transducers have foils of different thicknesses (1.5-2.3-4.2 microns). The voltage that is applied to them is periodically changed, in a stepwise fashion, passing through the following values with respect to the sputnik shell: +150, +3,000, +6,000, +11,000 volts. Lower-energy electrons that are trapped by the transducer are accordingly accelerated, and the signal from them is changed, too. This arrangement separates a lower-energy electron signal from other signals.

It has been established with the aid of these transducers that at high altitudes, the soft corpuscular radiation, first discovered by the third Soviet sputnik, is found not only at higher latitudes, but also at medium and lower latitudes. Thus, near the Brazilian magnetic anomaly at altitudes from 650 to 1,600 kilometres, several tens of millions of electrons with energies of more than 40 kev. are falling on the transducer screen every second. To give one an idea of what it is, it may be pointed out that with such an exposure the screen is blue violet and bright enough to be visible by the unaided eye. If such an energy stream had been absorbed by the atmosphere at altitudes of 200 to 300 kilometres, this would have led to its considerable heating.

#### CORPUSCULAR RADIATION

The remaining two electron transducers make it possible, using the sputnik's rotation around its axis, to study the distribution of directions of electron velocities in the Earth's magnetic field. Knowing this distribution and the laws governing the motion of charged particles in a magnetic field, it is possible to calculate the intensity of corpuscular radiation at the lower levels. In this way the intensity of corpuscular radiation can be determined not only at those altitudes where the sputnik is passing but also at other points along the same magnetic line of force.

Knowing the fashion in which the intensity of an electron stream depends on its direction, we can answer the question whether or not geoactive corpuscular radiation invades the denser layers of the atmosphere. A charged particle moving spirally around a magnetic line of force can enter the absorbing layers of the atmosphere at altitudes of 100 to 300 kilometres only if its direction of motion at very great heights is sufficiently close to that of the magnetic line of force. Normally, when the transducers "face" that way, they do not



register such particles. But if the axis of the transducer is perpendicular to the magnetic line of force, then the encountered stream of particles is very intense. This means that the recorded corpuscles "spend their lifetime" at high altitudes in the tenuous layers of the atmosphere where there is no absorption.

These particles are said to have been trapped by the Earth's magnetic field. But at the time of northern lights a tremendous amount of new corpuscles appear in the magnetosphere. The ability of the magnetic field to retain charged particles is diminished. At the same time the density of the atmosphere at great heights is increased. All this leads to a stronger absorption of geoactive particles by the atmosphere. Their stream from above downwards becomes, in fact, much greater than in the reverse direction. These cases can be detected by comparing the recordings of the transducers facing in the opposite directions. The data that have been analysed to this day show that at lower latitudes the magnetic trap in most cases is not destroyed. This suggests that corpuscular streams do not enter the denser layers of the atmosphere.

To study streams consisting of the softest corpuscles, the sputniks Cosmos 3 and Cosmos 5 carry special magnetic traps for the analysis of soft-ion energies.

#### GEIGER COUNTER

The sputnik instrumentation also includes a standard Geiger counter with a 3-mm. lead shield. This makes it possible to compare the intensities of soft geoactive corpuscles and electrons and ions of very high energies forming radiation belts around the Earth. At high altitudes in the radiation belts the counting rate of this instrument is greatly increased. Above the Brazilian magnetic anomaly high

count rates are recorded not only at considerable heights, but also at relatively small altitudes of the order of 200 to 400 kilometres. The intensive streams of low-energy corpuscles are often observed where the intensity of particles making up the radiation belts is small.

The continued operation of the sputniks inevitably calls for control and calibration of measuring instruments in the course of flight. To keep continuous watch over the functioning of the involved automatic gauges, regular check-ups are carried out in the sputnik on the power supply voltage, the work of particular units, the physical conditions in the hermetically sealed compartment and conditions on the surface of the sputnik. The analysis of these data has revealed a high degree of stability in all systems of the sputnik.

The sensitivity of the electron transducers during flight is controlled by means of a radioactive standard containing a hydrogen isotope—tritium. During measurements a stream of electrons emitted due to the radioactive decay of the tritium is not hitting the screen and so does not interfere with the measurement of geoactive corpuscles. But a special generator, which is switched on and off automatically, at regular intervals applies high voltage to the standard. The trajectory of electrons emitted by the standard becomes curved in such a way that the exposure of the screen becomes significant. Since the rate of radioactive decay of tritium is known and remains practically unaffected during the sputnik's functioning, such a procedure enables periodic check-ups to be made of the sensitivity of the electron transducers.

A great deal of information received from the sputniks Cosmos 3 and Cosmos 5 is still in the process of deciphering. The observations continue.

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#### UNIVERSITY DEVELOPMENT IN INDIA (A STATISTICAL REPORT, 1961-62)

**W**E have received a copy of the report prepared by the Statistical Section of the University Grants Commission, Rafi Marg, New Delhi-1, priced Rs. 3.50 nP. or 5 sh. It provides a useful and convenient summary of the latest facts and figures about the Indian Universities, and will be of value to all concerned in the development of higher education in India.

There are 53 universities in India of various types distributed among the 16 States (including

Delhi), which means that there is one university for every 8.34 millions of population. The total number of colleges is 1,783 of which 107 are university colleges, 1,223 are private colleges and 453 Government colleges. Of the 1,783 colleges 1,194 are Arts, Science and Commerce colleges and 589 are professional colleges.

The total number of students enrolled during 1961-62 was 980,380 of which 169,627 were women.

## ZEISS RESEARCH MICROSCOPES

AT the time of the Indian Science Congress, the India Representatives of VEB Carl Zeiss JENA will have on display some of the latest models of research microscopes.

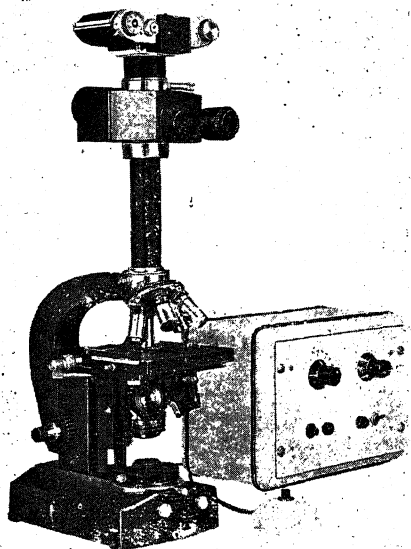


FIG. 1. "MF" Automatic Timer.

The "MF"-Automatic Timer represents a notable improvement of the Photomicrographic "MF"-equipment and consists of a novel basic body which—in conjunction with a switching unit—affords the automatic timing of the exposure period when taking photographs over the compound type of microscope. The outstanding advantage of the arrangement is that the Automatic Timer is not confined to be used with any definite instrument, but may be employed with any make of microscope. In other words, it is a material-saving and highly economical device that can be used in combination with photomicrographic work of any model of microscope. The equipment consists of an "MF"-basic body with shutter and of the switching unit for the Automatic Timer. The basic body is to be connected with the usual "MF"-tubes or adapters and then with the microscope. On to the basic body either the Camera attachment  $24 \times 36$  or the Camera attachment  $6 \times 6$  is to be fitted, also other conventional 35 mm.-cameras may be used, provided the camera-lens can be replaced by an "MF"-adapting piece. The switching unit operates on 220 V A.C. On its front panel the light-sensitivity of the photo-material used must be set, the range of sensitivity covering  $1^\circ$  to  $25^\circ$  DIN.

## RAMAN SPECTRA OF ADSORBED MOLECULES

IT is known that the infra-red spectra of molecules go through changes in position and intensity by their *adsorption* on solid surfaces. Thus there are experimental evidences to show that the infra-red spectra of organic molecules spread in *molecular layers* over the surfaces of inorganic salts exhibit differences in position and intensity of the bands compared with the spectra of bulk substances. The observed differences are greater the more the atomic distances of the vibrating groups coincide with the lattice distances of the salt surfaces. One notable feature of this effect is that the distortion of molecules with a centre of symmetry by the local fields of the lattice surface causes the appearance of Raman-active vibrations in the infra-red.

In a note to *Nature*, (1962, 195, 1196), G. Karagounis and R. Issa report some results obtained on the Raman spectra of organic molecules in the adsorbed state. The substances studied were biphenyl, naphthalene, anthracene,

*trans*-stilbene and terphenyl, in the state of monomolecular layers and polymolecular layers up to ten in number. As adsorbing material aerosil, porous glass or potassium bromide powder of great specific surface was used. Latest techniques were used for exciting and registering the Raman spectra.

The results show that the intensities of the Raman lines are very much equalized by the adsorption and that new lines appear in the case of molecules possessing a centre of symmetry. The new Raman lines are found to coincide with well-known infra-red bands of the molecules.

Another observation of interest was that the fluorescence of molecules was completely quenched by adsorption at a monomolecular layer and the masked Raman lines in this region come out prominently. This suggests the possibility of a convenient experimental method of studying the Raman spectra of fluorescent molecules.

## LETTERS TO THE EDITOR

ELASTIC MODULI OF GOLD AND SILVER BETWEEN  $-183^{\circ}$  TO  $300^{\circ}$  C.

By employing the composite piezo-electric oscillator method,<sup>1</sup> Young's modulus and rigidity modulus have been determined for pure specimens (99.99%) of gold and silver in the temperature range,  $-183^{\circ}$  to  $300^{\circ}$  C. For observations in the low temperature region,  $-183^{\circ}$  to  $30^{\circ}$  C., a cryostat fed by liquid oxygen was used. For the high temperature region, a suitable electric furnace was employed. Temperatures were maintained constant to  $\pm 5^{\circ}$  C. in the low temperature region and  $\pm 2^{\circ}$  C. in the high temperature region. For both the substances, the Young's modulus as well as the rigidity modulus decrease linearly with temperature. The curves could be represented by a function of the type,  $E_T = E_0 (1 - \alpha_E \cdot T)$  where  $\alpha_E = (1/E_0) \cdot (\partial E/\partial T)$ . The values of  $E_0$ ,  $\alpha_E$  and  $G$ , and  $\alpha_G$  are given in Table I.

TABLE I

	Gold		Silver	
	Observed	Calculated	Observed	Calculated
$E_0$ ..	$8.92 \times 10^{11}$	$9.50 \times 10^{11}$	$10.17 \times 10^{11}$	$10.10 \times 10^{11}$
$G_0$ ..	$3.05 \times 10^{11}$	$3.37 \times 10^{11}$	$3.23 \times 10^{11}$	$3.75 \times 10^{11}$
$\alpha_E$ ..	$2.90 \times 10^{-4}$	$2.75 \times 10^{-4}$	$4.09 \times 10^{-4}$	$3.59 \times 10^{-4}$
$\alpha_G$ ..	$2.83 \times 10^{-4}$	$2.81 \times 10^{-4}$	$3.30 \times 10^{-4}$	$3.48 \times 10^{-4}$

$E_0$  and  $G_0$  are in the units of dynes per cm.<sup>2</sup>

Our observations are compared against those of Neighbours and Alers<sup>2</sup> who have studied the temperature variation of the elastic constants of single crystals of these metals. From these single crystal values, the appropriate polycrystalline values of  $E$  and  $G$  are calculated using Voigt's relations.<sup>3</sup> Since these metals crystallise in the cubic system Boas<sup>4</sup> modifications do not have any effect on the method of averaging. These calculated values are also given in Table I. It is seen that the agreement is good in the case of gold, where under the microscope the specimen showed a grain size of 20 to 25 microns and complete random orientation of the grains. In the case of silver, the grains are needle-shaped with lengths and breadths measuring approximately 18 and 2 microns respectively, with the length of the grains parallel to the length of the specimen bar; this possibly explains the small departure

between the observed and calculated values of  $\alpha_E$  and  $\alpha_G$ .

We take this opportunity to thank the C.S.I.R. for a research grant which enabled us to build up the low temperature facilities. We are also thankful to the authorities of Sri Venkateswara University, where this work was done.

Dept. of Physics,  
Sri Venkateswara

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J. BHIMASENACHAR.

University,  
Tirupati, September 6, 1962.

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## NON-AQUEOUS TITRATION OF LEAD STYPHNATE

NORMAL lead salt of 2:4:6 trinitro resorcinol when dissolved in non-aqueous solvents like ethylene diamine, dimethyl formamide, etc., behaves like an acid and can be titrated with a suitable base. This fact has been taken advantage of in estimating lead styphnate potentiometrically in dry ethylene diamine<sup>1</sup> with sodium methoxide in benzene/methanol.<sup>2</sup>

The electrode system comprised of the usual sleeve type calomel electrode and the antimony-antimony oxide electrode as the reference and the indicator electrodes respectively. The Cambridge bench type pH meter has been used for following the course of the titration. The titration has been carried out in nitrogen atmosphere with 0.1N sodium methoxide employing 0.1-0.15 gm. of the lead salt in 30 ml. ethylene diamine. Thorough mixing of the solution during the titration was effected with a magnetic stirrer.

The averages of the results obtained with five batches are presented in Table I and compared with those obtained by the titanous chloride method, which is normally followed in the laboratory. It is clearly seen from the data that the results by the non-aqueous titration agree well within the experimental error with those of the titanous chloride method. In general the potentiometric methods are more sensitive and accurate than the visual titrimetric

methods, as they eliminate the personal error. Hence it is possible that the non-aqueous titration values may be more representative of the lead styphnate content than the titanous chloride method.

TABLE I

Estimation of lead styphnate by non-aqueous titration

No.	Batch No.	Potentiometric method	Titanous chloride method	% Diff.
1	685	97.66	98.0	0.35
2	692	97.40	97.5	0.10
3	703	97.72	97.6	0.12
4	704	97.66	98.0	0.35
5	705	97.57	98.0	0.44

A typical set of results are plotted in Fig. 1 which shows two clear well-defined inflexions. This is indicative of the suitability of the non-aqueous titration method for the analysis of lead nitro-resorcinates. Calculations are based on the assumption that the second inflexion point corresponds to one-third the molecular weight of the lead styphnate.

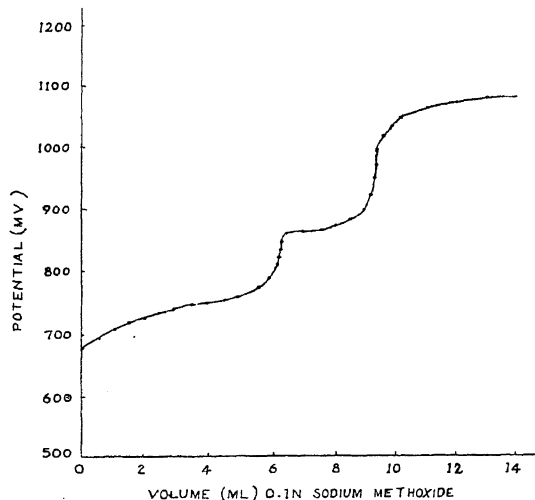


FIG. 1. Potentiometric titration of lead styphnate with sodium methoxide.

During the titration a yellow precipitate is formed. Further work is in progress to ascertain the nature of the above precipitate and also to extend the investigation to other solvents as also to other nitro-resorcinates.

Thanks are due to Mr. B. B. Chaudhuri and Dr. W. D. Patwardhan for their keen interest and to the Research and Development Organisa-

tion, Ministry of Defence, for their kind permission to publish this work.

Explosives Research and  
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Kirkee, Poona-3,  
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S. K. SINHA,  
S. R. NATU,  
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### DIPOLE MOMENTS AND STRUCTURE OF MOLECULAR COMPOUNDS OF ZINC AND CADMIUM HALIDES

THE metals of the first transition series form complexes of the type  $M^+X_{2.2}$  amine, where M is the metal atom and X is a halogen. Many of these compounds occur in two different forms which differ markedly in colour and physical properties.<sup>1</sup> For a metal atom with co-ordination number four, the possible configurations are sym. planar, cis or trans, or tetrahedral. Measurements of dipole moments on a few amine complexes of  $ZnCl_2$  and  $CdI_2$ , the former in dioxane and the latter in benzene at 35° C. are reported here.

Pyridine complexes of  $ZnCl_2$  and  $CdI_2$  were prepared by mixing aqueous solutions of the salts with pyridine, while those of  $ZnCl_2$  with aniline and *p*-toluidine, by mixing the alcoholic solutions of the two components and recrystallizing from alcohol.  $ZnCl_2 \cdot 2C_6H_5CN$  was prepared by dissolving anhydrous  $ZnCl_2$  in hot freshly distilled benzonitrile, which on cooling crystallized in white, hygroscopic crystals.

Measurements of dipole moments were made using the standard technique.<sup>2</sup> The moments of the complexes in Debye units are as follows:

$ZnCl_2 \cdot 2C_6H_5N$ ,	9.06;
$ZnCl_2 \cdot 2C_6H_5CN$ ,	7.88;
$ZnCl_2 \cdot 2p\text{-}CH_3C_6H_4NH_2$ ,	7.85;
$ZnCl_2 \cdot 2C_6H_5NH_2$ ,	6.69;
$CdI_2 \cdot 2C_6H_5N$ ,	9.37 D

In evaluation of these moments, the molar refraction value of  $ZnCl_2$  was taken as 19 c.c. used by Curran *et al.*<sup>3</sup> and that of  $CdI_2$  as 40.41 c.c. taken from critical tables<sup>4</sup> and those of the organic ligands from the data given by Vogel *et al.*<sup>5</sup> The total electron polarization of the molecular compound was taken as the sum of the polarizations of the metallic halide and the organic ligands.

The high moments observed for these complexes are due to their tetrahedral configuration though a significant part of it is due to atom

polarization. The moments of the  $\text{ZnCl}_2$  complexes reveal that the donor action of the ligand varies in the order: pyridine > benzonitrile > *p*-toluidine > aniline.

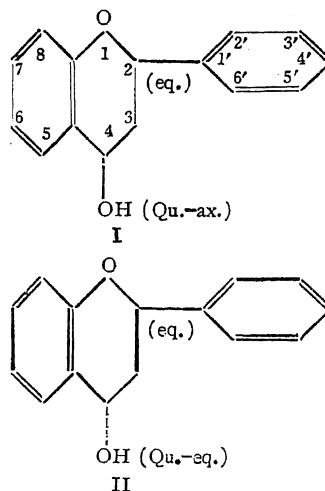
The authors are thankful to Prof. M. R. A. Rao, for helpful discussions and kind interest in this work.

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Indian Institute of Science,  
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## SYNTHESIS AND STUDY OF FLAVAN-4-OLS

FLAVONOID TANNINS are known to be derived by polymerisation of catechins and hydroxy flavan-3:4-diols (leuco-anthocyanidins). According to Freudenberg,<sup>1</sup> the condensation might be taking place between the 3 or 4-hydroxyl of one unit of hydroxy flavan with  $\text{C}_6$  or  $\text{C}_8$  of another flavan. It has also been recorded that 4-hydroxyl is more reactive in a flavan-3:4-diol than the 3-hydroxyl of a catechin.<sup>2</sup> It is, therefore, proposed to synthesise and study the reactivity of typical flavan-4-ols.



But reduction with sodium borohydride has not been fully studied with the flavanone systems. Pew<sup>5</sup> was the first to use  $\text{NaBH}_4$  to reduce 6-allyl-8-methoxy and 6-allyl-8:3':4'-trimethoxy flavanones; but he did not give the steric configurations of the products obtained. More recently Kashikar and Kulkarni<sup>6</sup> used this reagent and obtained 6-methyl-4'-methoxy flavan-4- $\beta$ -ol and showed that it is a quasi- $\beta$ -axial alcohol (I).

During our work on citromitin,<sup>7</sup> a number of flavanones of selective hydroxyl pattern became available which are now reduced with  $\text{NaBH}_4$  in alcoholic solution of the flavanone in presence of boric acid. The flavan-4-ols (see Table I) are precipitated by neutralisation

TABLE I

Methoxy Flavan-4-ols	m.p.	Formula	Found		Calculated	
			C	H	C	H
1. 6:4'- ...acetate	.. 148-49° .. 127-28°	$\text{C}_{17}\text{H}_{18}\text{O}_4$ $\text{C}_{19}\text{H}_{20}\text{O}_5$	71.29 69.88	6.45 6.45	71.31 69.50	6.30 6.09
2. 6:3':4'- ...acetate	.. 140-42° .. 110-11°	$\text{C}_{18}\text{H}_{20}\text{O}_5$ , $\frac{1}{2}\text{H}_2\text{O}$ $\text{C}_{20}\text{H}_{22}\text{O}_6$	67.14 67.39	6.52 6.24	66.62 67.04	6.46 6.15
3. 6:7:3':4'- ...acetate	.. 144-46° .. 118-20°	$\text{C}_{19}\text{H}_{22}\text{O}_6$ $\text{C}_{21}\text{H}_{24}\text{O}_7$	65.45 65.24	6.07 6.42	65.89 64.80	6.36 6.19
4. 7:8:3':4'- ...acetate*	.. 120-21° .. 95-96°	$\text{C}_{19}\text{H}_{22}\text{O}_6$ $\text{C}_{21}\text{H}_{24}\text{O}_7$	65.68 64.92	6.30 6.21	65.89 64.80	6.36 6.19
5. 5:6:7:8:3':4'- flav-3-ene	.. 95-96° ..	$\text{C}_{21}\text{H}_{24}\text{O}_7$ , $\frac{1}{2}\text{H}_2\text{O}$	63.80	6.27	63.48	6.29

\* See Reference 8.

Flavan-4-ols have been synthesised and their conformations studied recently by Kulkarni *et al.*<sup>3</sup> and Bogner *et al.*<sup>4</sup> Among the reagents employed, Pt-H, Raney-Ni-ethanol, ammoniacal titanous chloride and  $\text{LiAlH}_4$  were shown to give rise to quasiallial- $\beta$ -flavan-4-ols (I), while Al-Hg was shown to give rise to quasi-equatorial- $\alpha$ -isomer (II).<sup>4</sup>

with acetic acid as colourless crystalline compounds. The yield of flavan-4-ols is invariably good (80-85%) in this synthesis.

The reduction of 6-methyl-4'-methoxy flavanone<sup>6</sup> was repeated with  $\text{NaBH}_4$  and the flavan-4-ol had the same melting point recorded for the quasi-axial- $\beta$ -flavan-4-ol (I), previously obtained by the use of  $\text{LiAlH}_4$ .<sup>3,6</sup> It has also

been shown that metal hydrides generally give rise to  $\beta$ -axial flavan-4-ols (I). In conformity to this conclusion, the flavan-4-ols recorded above give rise to stable acetates with pyridine-acetic anhydride. When kept in 3% HCl-glacial acetic acid at 60° for 15 mins., only the acetates are formed (I.R. Spectrum 1754  $\text{cm}^{-1}$  for acetate). Neither dehydration nor polymerisation of the flavan-4-ol was noticed. But at higher temperature with this reagent or when kept for a longer time, invariably tannin-like uncrystallisable products were obtained.

Citromitin (5 : 6 : 7 : 8 : 3' : 4'-hexamethoxy flavanone)<sup>7</sup> differs significantly from the rest. Reduction with  $\text{NaBH}_4$  gave a compound which did not give an acetate showing the absence of free hydroxyl. Its analysis also indicated dehydration; the compound may, therefore, be regarded as a hexamethoxy flav-3-ene.

The action of  $\text{POCl}_3$ -pyridine on these flavan-4-ols gave rise to mixtures which could not be separated effectively either by fractional crystallisation or by chromatography on alumina. However, analysis of close melting fractions showed partial dehydration.

A reaction that deserves mention is the exhibition of colours when these flavan-4-ols are treated with conc.  $\text{H}_2\text{SO}_4$  or with HCl in glacial acetic acid or in alcohol. Intense blue-violet or purple colours are noticed. These colours differ from those of anthocyanidins (red to reddish-orange or pink) and may indicate a profound change of the flavan-4-ols in strongly acid medium. Roux<sup>2</sup> regards this colour reaction as characteristic of flavan-4-ols and used it for the detection of this group in tannins.

Our grateful thanks are due to Prof. N. V. Subba Rao of Osmania University for the I.R. spectra.

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## THE NATURE OF INTERFERENCE OF CYANIDE IN LOWRY'S METHOD

Of the several methods of estimation of proteins, the method of Lowry *et al.*<sup>1</sup> is considered as the most sensitive and accurate one. This method is being extensively used in protein analysis.<sup>2,3</sup> In the course of fractionation of hæmoglobin in columns of Amberlite IRC-50 (XE 64) with chromatographic developer containing KCN, this method was tried for determining the protein content of each effluent fraction and we invariably encountered a high blank. The present note deals with the nature of interference of KCN, with particular emphasis on the kinetics of colour development.

The method of Lowry *et al.*<sup>1</sup> was strictly followed. In our experiments, aqueous solutions of KCN (0.2 ml.) was treated with alkaline copper (2 ml.) followed by 1% acetic acid or 1% NaOH to get the required pH. Distilled water was added to get uniform volume and finally 0.2 ml. of phenol reagent (1:1 with distilled water) was added quickly and the colour intensities were measured after half an hour at 530  $\mu$  in a Lumetron Photoelectric colorimeter with water as blank. The pH of the final resulting solution was also recorded.

TABLE I

Colour intensities of chromatographic developers with and without KCN expressed as Tyrosine Units

	Tyrosine Units*
1. Chromatographic developer (buffer) without KCN. pH 6.33 ..	Nil
2. Chromatographic developer (buffer) 0.5 ml. treated as given in text with KCN (0.01 M.). pH 6.33 ..	5.5

\* One Unit of Tyrosine is taken as the colour due to 10  $\mu\text{g}$ . of tyrosine.

From the results presented in Table I, it can be seen that cyanide intensifies the colour to a great extent. However, aqueous solution of KCN, subjected to this procedure, gave an initial colour which faded after some time (Fig. 1-Curve A); whereas the colour obtained with the chromatographic developer containing KCN was high and stable (Table I). This prompted us to study the intensity of colour formed with a fixed concentration of cyanide (200  $\mu\text{g}$ .) with respect to a final pH (Fig. 2). It was interesting to note that maximum colour was observed at a final pH of 8.25. The colour intensities with a fixed concentration of KCN

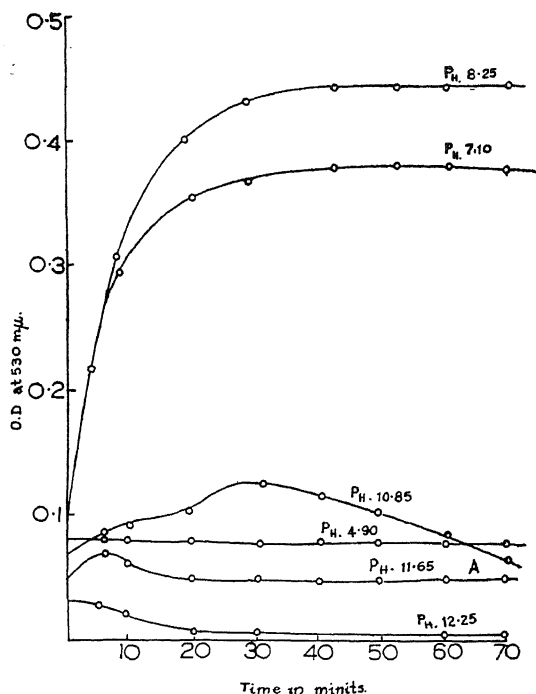


FIG. 1. Colour intensities with KCN (200  $\mu$ g.) with respect to final pH and time.

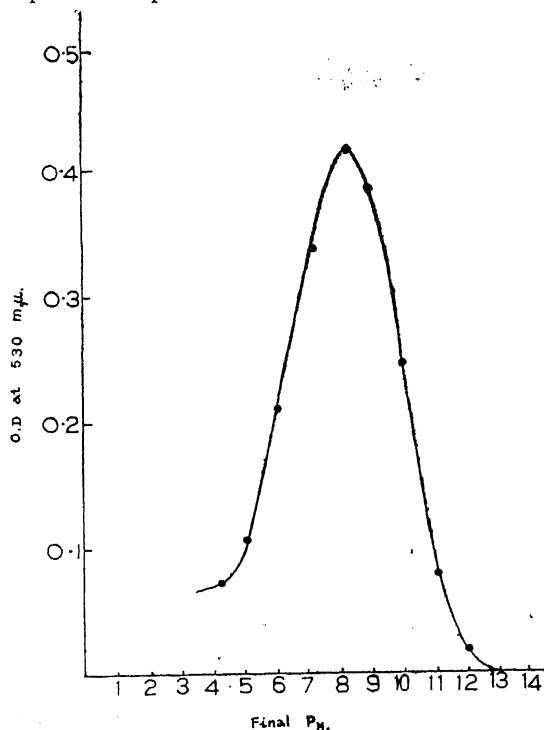


FIG. 2. Colour intensities with KCN (200  $\mu$ g.) at different final pH values, colour being measured after 30 min.

(200  $\mu$ g.) differing in final pH were followed with respect to time. Again maximum colour was observed only at a final pH of 8.25 (Fig. 1). However, there is one striking difference between the colour intensities of KCN at the final pH of 8.25 and tyrosine, inasmuch as the colour due to the former is stable even after 24 hrs. whereas the colour due to the latter disappeared after 4 or 5 hrs.

From the results presented, it is clear that cyanide interferes in Lowry's method of estimation of protein and this reaction is pH dependent, with an optimum final pH of 8.25. It will be that buffers at and near neutral pH, containing even as little as 0.01 M KCN, will enhance the colour in this method. Most of the basic and neutral proteins, like haemoglobin, are generally fractionated in columns with buffers (developers) in and near neutral pH.<sup>4,5</sup> Further, it is known that inclusion of KCN in buffers for the fractionation of haemoglobin results in better resolution of different components.<sup>6,7</sup> Naturally, evaluation of protein concentration in such cases by this method<sup>1</sup> can be attempted only with caution.

We are thankful to Professor Oliver H. Lowry, of Washington University, St. Louis, Missouri, U.S.A., for the interest shown in this work and to Professor H. R. Cama, of the Indian Institute of Science, Bangalore, for the generous gift of Amberlite-IRC 50 (XE 64). One of us (K. V.) is grateful to the Government of India for the award of a fellowship.

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# PECTIN TRANS-ELIMINASE ACTIVITY IN STREPTOMYCES VIRIDIOCHROMOGENES

THE enzyme pectin *trans*-eliminase (PTE) was first reported by Albersheim *et al.*<sup>1</sup> in a commercial pectinase, and later detected in phytopathogenic *Erwinia* and *Bacillus* sp.,<sup>2,3</sup> *B. polymyxa*<sup>4-6</sup> and fungi.<sup>7</sup> This enzyme splits the  $\alpha$ , 1-4-glycosidic bonds in pectin by a *trans*-elimination mechanism, the breakdown product of which shows marked absorption peak in the region of 230 to 235  $m\mu$ , and reacts with thiobarbituric acid to give a product which has an absorption maximum around 547  $m\mu$ .<sup>8,9</sup>

The present note deals with the detection of PTE in a pectinase obtained from *S. viridochromogenes*, a highly efficient pectolytic culture, which was found to possess both pectin polygalacturonase and pectin methylesterase activities.<sup>10,11</sup> The test for PTE activity was made by a method similar to that described by Nagel and Vaughn,<sup>6</sup> which consisted of adding 0.1% pectinase solution to a buffered substrate (pH 8.0) containing 0.001 M calcium chloride. Both pectin NF (S. B. Penick and Co., Illinois) and polygalacturonic acid (Eastman Kodak Co., Rochester) were tested as substrates. At the end of 24 hours at room temperature (25°C.) the reaction mixture was studied for absorption spectrum in the range of 220 to 250  $m\mu$  using a Beckman DU spectrophotometer. With pectin as a substrate the maximum absorption value was observed at 235  $m\mu$  while with polygalacturonic acid maximum absorption value was at 232  $m\mu$  (Fig. 1) thus indicating the presence

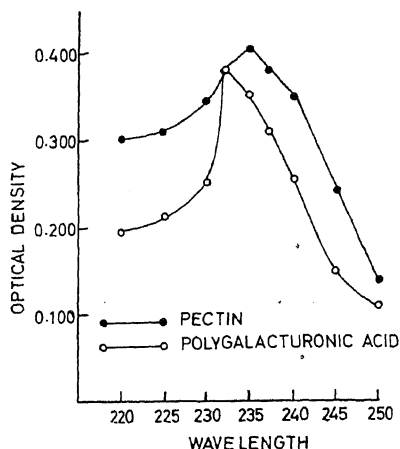


FIG. 1

of a *trans*-eliminase mechanism for the breakdown of pectic substances. That one of the end products of this reaction was a digalacturo-

nide of the type reported in literature<sup>12</sup> was confirmed by the thiobarbiturate reaction described by Albersheim *et al.*,<sup>1</sup> and the reaction mixture gave an absorption maximum at 548  $m\mu$  for both pectin and polygalacturonic acid as substrates (Fig. 2).

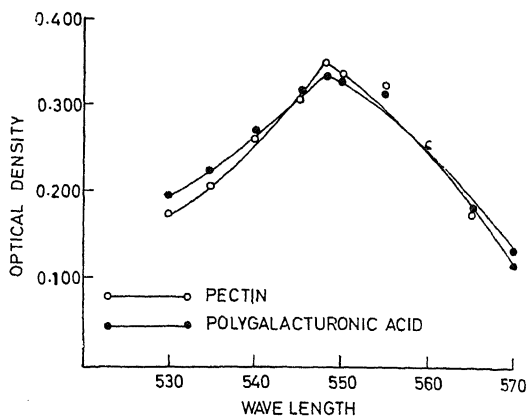


FIG. 2

In an attempt to determine whether the enzyme was calcium dependent or not, the enzyme reaction was carried out in presence of 0.001 M. EDTA, when it was completely inhibited in contrast to the normally proceeding reaction of the control. The pH optimum of this activity was also observed to be around pH 8.0. It was also noted that pectin was preferred to polygalacturonic acid as a substrate and hence the name pectin-*trans*-eliminase has been given to this enzyme.

This is the first report on pectin *trans*-eliminase in a culture belonging to the genus *Streptomyces*, viz., *S. viridochromogenes*. A detailed investigation of this culture, among others, is in progress and will be the subject of a full communication in future.

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#### A NOTE ON THE SEDATIVE AND OTHER CONSTITUENTS OF *DAPHNE PAPHNACEA*

The plant *Daphne paphnacea* Wall. ex Steud. (N.O. Thymelaeaceae) has been used as bitter, purgative and febrifuge.<sup>1</sup> No other information about its other medicinal uses is available in literature though its use in curing insanity is known locally. Results of systematic chemical investigation and preliminary pharmacological investigation, carried out on the roots of the drug in our laboratories, are reported here.

From the unsaponifiable fraction of the petroleum ether (60–80°) extract, one sterol (m.p. 131–32°; C = 76.9%, H = 11.09%; mol. wt. by Rast's method 388.3) was isolated. C<sub>26</sub>H<sub>44</sub>O<sub>3</sub> requires C = 77.22% and H = 10.89%.

From the alcoholic extract, three glycosides, viz., G<sub>1</sub>, m.p. 195–97° decomp., C = 56.92%, H = 4.92%, mol. wt. by Rast's method 373.9 (C<sub>18</sub>H<sub>18</sub>O<sub>9</sub> requires C = 57.14%, and H = 4.76%), G<sub>2</sub>, m.p. 175–77° decomp., C = 53.94%, H = 4.415%, mol. wt. 522.5 (C<sub>28</sub>H<sub>22</sub>O<sub>13</sub> requires C = 54.54% and H = 3.4%) and G<sub>3</sub> were isolated. G<sub>1</sub> and G<sub>2</sub> exhibited colour reactions characteristic of the flavonoids. G<sub>3</sub> was obtained as a semi-solid mass and could not be crystallized. However, it was not flavonic in nature. Hydrolysis of G<sub>1</sub> and G<sub>2</sub> yielded aglycones GA<sub>1</sub> (m.p. 270–275° decomp.) and GA<sub>2</sub> (m.p. 225–229° decomp.) respectively. The sugar moieties present in them were identified as glucose.

The resin fraction, obtained from the alcoholic extract, after repeated washings with ether, melted at 212–15° (decomp.). From the ether solution two resin acids having melting points 188–90° and 160–61° respectively could be separated.

A reducing sugar present in the plant was identified to be glucose.

Preliminary pharmacological investigations on anaesthetized and unanaesthetized dogs and cats revealed that the detannated alcoholic extract and the isolated impure glycoside G<sub>3</sub> have hypotensive and tranquillizing effects.

Doses of 0.2 ml. and 0.4 ml. of the detannated extract (1 ml. representing 0.5 gm. of the drug) produced a fall in blood pressure of a male anaesthetized dog weighing 3.6 kg. (Pentobarbital sodium—35 mg./kg.i.p.) to the extent of 22 and 44 mm. Hg respectively. However, the fall in blood pressure was transitory and in both cases normal level was attained in 20 to 35 seconds. The tranquillizing effect was studied on unanaesthetized healthy dogs of both sexes weighing between 5.7 and 6.9 kg. Two doses of the detannated alcoholic extract representing 342 mg. and 516 mg. of the drug per kg. body weight of the animal produced sedation lasting for 1 hour and 40 minutes and 2 hours respectively followed by complete recovery. A dose of 1.12 mg./kg. of the isolated impure glycoside G<sub>3</sub> produced sedation lasting for 1 hour followed by complete recovery.

The total alcoholic extract was found to be toxic in nature in higher doses, perhaps due to the presence of flavone glycosides. Doses of the extract representing 685 mg. and 513 mg. of the drug/kg. body weight of the animal proved to be fatal when tested on normal unanaesthetized healthy cats and dogs. Lower doses of 265 mg./kg. and 171 mg./kg. were well tolerated.

Further work is in progress.

We are indebted to Sri. Prajapati Joshi, Pharmaceutical Expert to Government of U.P., for drawing our attention to this plant and for the supply of the drug.

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#### ALGINIC ACID CONTENT OF SOME OF THE BROWN SEAWEEDS OF SAURASHTRA COAST

Of the many commercially important chemicals derived from seaweeds, alginic acid and its salts find their application in food, pharmaceutical, cosmetics, paper and textiles industries.<sup>1</sup> It is also employed in the production of synthetic fibres known as Alginate fibres.<sup>2</sup> Though alginic acid-bearing seaweeds are widely distributed on Indian coast very little information is available regarding the alginic acid content of these

seaweeds. Valson<sup>3</sup> in a note presented data for the alginic acid content of some of the brown seaweeds of Gulf of Mannar area.

This note records the results of the determination of the alginic acid content of some of the common brown seaweeds of the Saurashtra coast. The weeds were collected from Okha, Porbandar, Sikka and Dwaraka. The seaweeds after collection were washed thoroughly in sea-water and then rinsed well in freshwater before drying in the sun.

The air-dried seaweed was finely pulverised and moisture determined by drying the sample at 110° C. for two hours.

0.5 gm. samples of the finely powdered (— 100 mesh) air-dried material were used for the estimation of alginic acid by the method recommended by Cameron, Ross and Percival.<sup>4</sup> The results are given in Table I.

*muricatum* which are found in relatively small quantities.

The authors express their grateful thanks to the members of the Algology Division of this Institute for their help in the collection, and to Dr. (Mrs.) Thivy for the identification of the species reported in this investigation.

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TABLE I

*Alginic acid content of the seaweeds on the basis of air-dried material*

Name of the seaweed	Place of collection	Date of collection	Moisture %	Alginic acid %
<i>Sargassum tenerrimum</i> J. Ag.	.. Okha Fisheries	10-1-1962	7.89	10.08
<i>Sargassum</i> sp.*	.. Okha Port Reef	8-4-1962	10.13	19.88
<i>Sargassum</i> sp.* (Plants from pools)	.. do.	6-5-1962	8.47	18.14
<i>Sargassum</i> sp.* (Plants from exposed rocks)	.. do.	5-5-1962	9.24	20.48
<i>Sargassum</i> sp.*	.. do.	4-6-1962	11.97	23.09
<i>Sargassum johnstonii</i> Setch and Gard	.. do.	4-6-1962	11.16	22.34
<i>Sargassum tenerrimum</i> J. Ag.	.. Dwaraka	10-1-1962	8.83	4.85
<i>Sargassum</i> sp.*	.. do.	5-6-1962	10.90	27.49
<i>Sargassum cinereum</i> J. Ag. var. <i>berberi-folium</i> Grun.	.. do.	5-6-1962	11.69	29.17
<i>Sargassum</i> sp.†	.. Porbandar	10-1-1962	15.08	7.12
<i>Sargassum tenerrimum</i> J. Ag.	.. Sikka	6-12-1961	13.52	14.77
<i>Dictyota</i> sp.	.. do.	6-5-1962	9.64	5.50
<i>Sargassum</i> sp.*	.. do.	6-5-1962	12.34	21.28
<i>Cystophyllum muricatum</i> (Turn.) J. Ag.	.. do.	6-5-1962	9.32	19.74
A member of the family Cystosereaceæ (Brown algæ)	Veraval Port	31-5-1962	11.49	19.34

\* Species with flat stems and linear-lanceolate leaves.

† A species resembling *Sargassum tenerrimum* J. Ag. but differing from it by the presence of a few small spines on leaf-stalk and stem.

A comparison of the values given in Table I, with those presented by Valson for the same species of Gulf of Mannar area (*Sargassum* sp. 19.22; *Cystophyllum muricatum* 15.63; *Padina* 10.35) shows that the seaweeds of Saurashtra coast, in general, contain a greater percentage of alginic acid. It is also observed from the results that the seaweeds which grow in fairly large quantities, namely, *Sargassum tenerrimum* from Okha Fisheries, Dwaraka, and Porbandar contain lower percentages of alginic acid than *Sargassum johnstonii*, *Sargassum* sp., *Sargassum cinereum*, and *Cystophyllum*

## VARIATION OF YOUNG'S MODULUS IN LIMESTONES

THE pulse technique<sup>1</sup> involving the phenomenon of critical transmission was employed to determine the Ultrasonic Velocities both longitudinal ( $V_l$ ) and torsional ( $V_t$ ) in km./sec., in limestones of Tandur (Andhra Pradesh). The data obtained in few cases is tabulated along with the density ( $\rho$ ) in gm./c.c., Young's modulus ( $Y$ ) in  $10^{11}$  dynes/cm.,<sup>2</sup> and the percentage deviations of density ( $\Delta \rho$ ) and Young's modulus ( $\Delta Y/Y$ ) from their mean value, of 25 samples,

TABLE I

S. No.	$\rho$	$V_t$	$V_i$	$Y$	$\frac{\Delta \rho}{\rho} \%$	$\frac{\Delta Y}{Y} \%$
1	2.709	6.41	2.47	4.758	0.31	13.54
2	2.710	6.52	2.41	4.540	0.35	9.38
3	2.707	6.33	2.39	4.220	0.24	2.52
4	2.704	6.41	2.28	4.204	0.13	- 2.23
5	2.640	6.58	2.38	4.254	-0.23	3.30
6	2.719	6.27	2.40	4.434	0.68	7.22
7	2.699	6.30	2.28	3.984	-0.58	- 3.30
8	2.681	6.17	2.22	3.778	-0.73	- 8.25
9	2.703	6.86	2.21	3.879	0.90	- 6.05
10	2.702	6.59	2.14	3.550	0.53	-15.88

A perusal of Table I shows that the longitudinal velocities in the samples investigated range from 6.00 to 6.86 km./sec., whereas the torsional velocities vary from 2.14 to 2.50 km./sec. This scatter is presumably due to variations in density, porosity, composition, etc., and this is in accordance with that of Shimozuru.<sup>2</sup>

The significant result of the present investigation is the predominating part played by density (2.64-2.72), in causing a change in values of Young's modulus 3.55 to 4.76. Such variations are normally difficult to visualise. One can observe from the percentage deviations, the large variation of ( $Y$ ) of the order of 30%, due to small variation in values of density of the order of 1.6%. Thus it is evident that the density plays an important part in causing a large change in the value of ( $Y$ ) as pointed out by Ide.<sup>3</sup>

It has also been found that the value of ( $Y$ ) depends upon the percentage composition of calcium carbonate present in these limestones and it increases with the increase of the  $\text{CaCO}_3$  content. Differential Thermal Analyser (DTA) has been employed to determine the  $\text{CaCO}_3$  content. Further studies on similar lines might reveal some useful information on physical properties of limestones and this dependency on the density and chemical composition.

The authors desire to express their grateful thanks to Dr. S. Balakrishna for his encouragement and guidance in carrying out this work.

Geology Department,  
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August 28, 1962.

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Y. SUBRAHMANYAM.

# BREEDING HABITATS OF INDIAN *CULICOIDES* (DIPTERA, CERATOPOGONIDAE)

RECENT taxonomic studies<sup>1,2</sup> enlist 32 species and 1 variety of *Culicoides* from the Indian territory but their breeding habitats like other Oriental species are very little known. The present communication reveals natural breeding sites of several Indian species determined in the laboratory through extensive rearing of the imagines from the immature stages residing in the samples of soil and banana vegetation. In course of the work, soil samples from fringe areas of stock ponds and the decomposed bases of the banana plants were widely tested. Following standard procedures, materials were collected from Calcutta and the neighbouring areas. A part of the soil sample of a particular collection was first sieved under pressure from a strong jet of water and was followed by treatment of the materials escaping through the sieves of 4, 16 and 76 meshes per square inch respectively with concentrated sugar solution in water. Immature stages present in the material underwent the effect of flotation process and were held up to the surface of the medium indicating positive nature of the collection. Materials of the collection were then distributed in small earthenware receptacles which, in turn, were placed inside standard Barraud's cages for rearing out the imagines. With samples of vegetation, a part of it was directly examined for the presence of immature stages particularly the larvæ by teasing the fibres apart with needles. In case of a positive detection, the materials of collection were placed inside the cages like the soil samples. Daily collection of the imagines was thereafter made.

It was found that a certain soil sample yielded one, more than one or all of the four species, viz., *C. alatus* Das Gupta and Ghosh, *C. turgidus* Sen and Das Gupta, *C. peregrinus* Kieffer and *C. similis* Carter, Ingram and Macfie, while the sample of banana vegetation yielded one, more than one or all of the four species, viz., *C. palpifer* Das Gupta and Ghosh, *C. candidus* Sen and Das Gupta, *C. distinctus* Sen and Das Gupta and *C. innoxius* Sen and Das Gupta.

In systematic collection of the imaginal forms in the above way, definite pattern in the imaginal emergence could be traced. Representative data of two instances are shown in Table I.

In the above systematic rearings, it was found that the average yield of the imaginal forms from 225 cubic inch of soil sample was 328 with the range between 176 and 556. Duration of

1. Krishnamurthy and Balakrishna, *Proc. Ind. Acad. Sci.*, 1953, 38.
2. Shimozuru, *Jap. Jour. Geophys.*, 1960, 2.
3. John, M. Ide, *Prac. Nat. Acad. Sci.*, 1936, 22.

TABLE I

Laboratory breeding of *C. alatus* population  
from soil samples collected around Calcutta

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		9th	48	
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		12th	12	
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Thakurpukur	4	1st	264	452
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yield, in such cases, lasted between 3 and 13 days, and depending on the peak of emergence, two distinct patterns were traced. In one case, the peak was encountered at the middle of the period necessary to exhaust the sample (Fig. 1: *a-a'*), while in the other case, this was at the very beginning, the yield falling steadily with days (Fig. 1: *b-b'*).

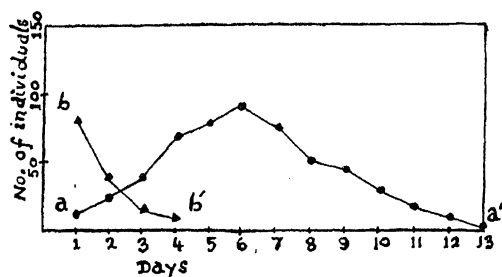


FIG. 1. Curves depicting the emergence patterns of the imaginal forms of *Culicoides* in laboratory breeding from soil samples; *a-a'* depicts the pattern where the peak is encountered at middle while *b-b'* depicts the pattern with peak at the very beginning.

Present study shows yet another natural recess, the muddy fringe areas of stock ponds, wherein *C. similis* Carter, Ingram and Macfie and *C. peregrinus* Kieffer may breed. The former, in Africa,<sup>3</sup> has been found to breed inside canoes towed near river banks, and the latter, in India<sup>4,5</sup> and Malaya,<sup>6</sup> is known from variable sites as in small pools or streamlets, in drain of sluggish water, in algae growing in overflow-water and even in old manure heaps.

Data presented now on duration of rearing may clarify misconception about similar works as pointed out by Hill<sup>7</sup> on Buckley's laboratory rearing of *Culicoides*.<sup>6</sup> It is apparent that the period cited in such mass rearing is not indicative of the length of larval or pupal stages of a species. It rather shows the period over which the imaginal forms continue to emerge from the immature stages of development residing in the sample collected.

Department of Zoology, S. K. DAS GUPTA.  
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### THYROID FOLLICLES IN THE KIDNEY OF CARPS

THYROID gland in fishes is normally present below the floor of the pharynx, on the tongue, between the gill arches as far back as the origin of the third and fourth afferent branchial arteries (Gudernatsch, 1911).<sup>1</sup> Smith and Coates (1937)<sup>2</sup> reported on the histological structure of normal and hyperplastic thyroid in *Rasbora lateristriata* (Bleeker). Chavin (1956)<sup>3</sup> described the thyroid follicles in the head kidney of *Carassius auratus* (Linnaeus). Baker (1958 a, 1958 b)<sup>4,5</sup> added her remarkable observations on the heterotopic thyroid tissue in platyfish. While working on the functional morphology of fish kidney, occurrence of thyroid follicles scattered in the organ of *Catla catla* (Ham.), *Cirrhina reba* (Ham.), *Puntius sarana* Ham. and *Labeo dero* (Ham.) was noticed.

The kidneys were fixed in Bouin's fluid, Carnoy and Formol-calcium. Sections were cut at 7  $\mu$  and stained with Ehrlich's hæmatoxylin and eosin. Histochemical tests for polysaccharides, lipids and proteins were employed to find out the chemical nature of the renal thyroid colloid.

Thyroid follicles in *Catla catla* and the other carps mentioned above are restricted usually to the head kidney but in one specimen of *Catla* they were observed in the functional meso-

vell. The follicles are few and scattered. They are smoothly spherical or ovoid in size, shape and number exhibit. In the head kidney the thyroid is surrounded by its hematopoietic tissue which is less dense in *Catla* than in other species. The follicular epithelium consists of a few fragile flattened cells with small and faintly staining nucleus. In *reba*, *P. sarana* and *Labæo dero* the follicles are compact. The follicle contains a large amount of eosinophilic colloid material. Some of the colloid is seen in the lumen of a few follicles. In several cases is considerably more dense than this is probably due to the action

of the colloid gave a strong PAS positive reaction. The colloidal substance was found to be resistant thereby proving the absence of lipids. No acid mucopolysaccharides were detected as was indicated by negative reaction with Alcian blue tests. The material was not extracted either by acetone or hot chloroform/methanol solution, it is pointing to the absence of lipids. It is inferred that the positive PAS reaction is due to the presence of either a mucoprotein or glycoprotein as seems likely in view of the presence of polysaccharides and lipids. The acidic nature of the colloid was also indicated by the reaction with mercury-bromophenol blue and Alcian blue.

953)<sup>6,7</sup> accounted for the presence of mucopolysaccharides in the thyroid. The use of the help of dialysed iron test only gave a positive reaction. The present histology on the colloid could not localize the presence as negative reactions were obtained with Alcian blue and dialysed iron test in alcohol as well as Formol-calcium-alcohol. Further, Fisher got a positive reaction only in the absence of alcohol. A strong PAS positive reaction was obtained irrespective of the different fixatives used in the present investigation. Fisher's interpretation of reactions cited above as being due to the difference between the materials used, on the action of the different fixatives, observation, however, does not seem to hold for the renal thyroid colloid in

presence of heterotopic thyroid follicles; a recent discovery. Conflicting results exist on its chemical nature. More work is necessary before any definite conclusion can be arrived at regarding the

origin, distribution and functional significance of the sporadic thyroid follicles. Work on the detailed chemical analysis of the colloid, the follicular growth in relation to age and sex and the effect of certain chemicals on thyroid tissue is in progress.

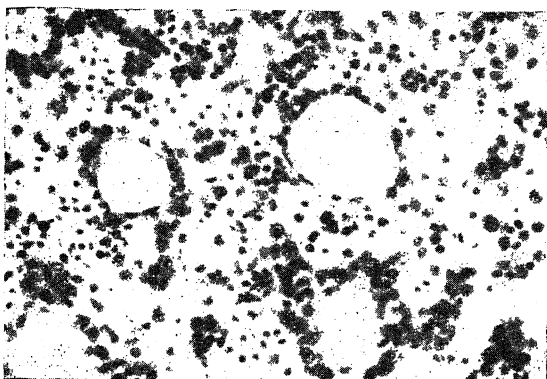


FIG. 1. Section through the head kidney of *Catla catla* showing two thyroid follicles,  $\times 460$ . (Photo-micrograph).

The author is indebted to Dr. (Miss) M. Chandy for guidance and constant encouragement. Sincere thanks are also due to Prof. B. R. Seshachar, for providing facilities in the Department.

Department of Zoology, SURENDER K. AHUJA.  
University of Delhi,  
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#### NOTES ON THE OCCURRENCE OF CLADOCERA IN THE MADRAS COASTAL WATERS

THE routine analyses of surface plankton samples during the period August 1958 to August 1961 indicated that Cladocera was represented in the plankton by *Evadne tergestina*, *Podon* sp., and *Penilia avirostris*. It was significant that maxima of Cladocera followed months of diatom abundance. The maxima of *Evadne* occurred sometime between the period March and May when the salinity ranged from 33.11‰ and 34.45‰ and the temperature between 28.5°C. and 30.0°C.

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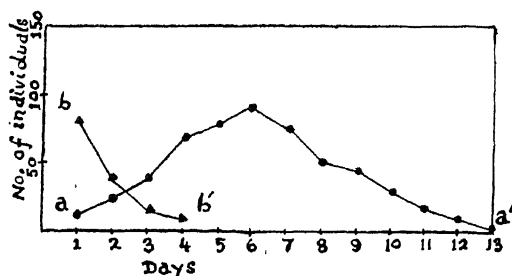


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The kidneys were fixed in Bouin's fluid, Carnoy and Formol-calcium. Sections were cut at 7 $\mu$  and stained with Ehrlich's hæmatoxylin and eosin. Histochemical tests for polysaccharides, lipids and proteins were employed to find out the chemical nature of the renal thyroid colloid.

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Thyroid colloid gave a strong PAS positive reaction. The colloidal substance was found to be saliva-resistant thereby proving the absence of glycogen. No acid mucopolysaccharides were present as was indicated by negative dialysed iron and Alcian blue tests. The colloidal material was not extracted either by hot pyridine or hot chloroform/methanol mixture, thus pointing to the absence of lipids. It is thus inferred that the positive PAS reaction signifies the presence of either a mucoprotein or a glycoprotein as seems likely in view of the absence of polysaccharides and lipids. The proteinic nature of the colloid was also confirmed by mercury-bromophenol blue and Millon's tests.

Fisher (1953)<sup>6,7</sup> accounted for the presence of acid mucopolysaccharides in the thyroid colloid with the help of dialysed iron test only in alcohol-fixed material. The present histochemical study on the colloid could not localize this substance as negative reactions were observed with Alcian blue and dialysed iron reactions in alcohol as well as Formol-calcium-fixed material. Further, Fisher got a positive PAS reaction only in the absence of alcohol fixation. A strong PAS positive reaction was observed irrespective of the different fixatives used in the present investigation. Fisher interpreted the two reactions cited above as being due to the solubility difference between the materials depending upon the action of the different fixatives. This observation, however, does not seem to hold good for the renal thyroid colloid in these fishes.

The occurrence of heterotopic thyroid follicles in fishes is a recent discovery. Conflicting opinions exist on its chemical nature. More extensive work is necessary before any definite conclusions can be arrived at regarding the

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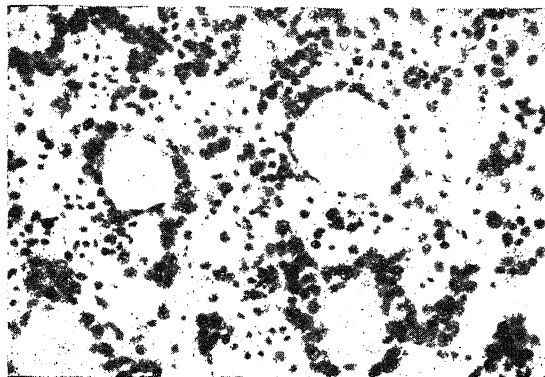


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*Penilia* in the surface samples attain their peak numbers in October when the salinity is 30.92‰ and temperature 29.5° C. Though Cattley and Harding<sup>1</sup> have recorded the occurrence of *Penilia* in the North Sea plankton, these authors as well as Fuller<sup>2</sup> consider that this species is unlikely to establish there since the area is well outside the 18° C. mean annual surface isotherm which usually limits the species. *Podon* sp. contributes only 25% to the total Cladocera in the plankton. During the rest of the year the Cladocera are either scarce or completely absent.

None of the observations from Indian waters contain any information on the sex of *Penilia*,

My thanks are due to Dr. S. Krishnaswamy for guidance and interest in the work.

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Madras-5, July 20, 1962.

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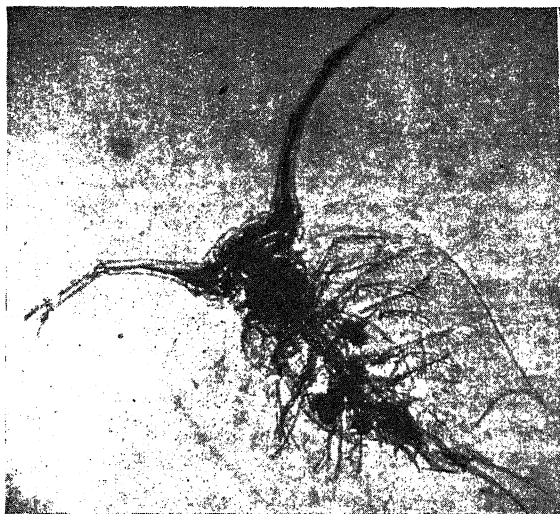


FIG. 1

Fig. 1. A specimen of *Penilia* with eggs,  $\times$  ca. 50.



FIG. 2

Fig. 2. A specimen of *Penilia* with embryos,  $\times$  ca. 75.

although *Penilia* have been reported by Muthu<sup>3</sup> and Prasad.<sup>4</sup> Of over a thousand specimens of *Penilia* examined at Madras, during the present observations no males have been encountered. But many specimens carried either eggs or embryos (*vide* Figs. 1 and 2). Since the males were absent in all the samples, it is probable that *Penilia* reproduce by parthenogenesis in Indian seas. Lochhead<sup>5</sup> suggested that it may well be that in some areas *Penilia* reproduces only by parthenogenesis, probably without the production of resting eggs since males were recorded only from Hongkong, Naples, the Adriatic, the Black Sea, off Sydney (Australia) and Woods Hole. However, more information on this question is necessary before this can be proved conclusively.

#### REPRODUCTION IN THE MALE SLENDER LORIS, *LORIS TARDIGRADUS* *LYDEKKERIANUS*, CABR.

CYCLICAL reproductive phenomena are generally characteristic of mammals living in temperate and subarctic regions. Such extreme environmental variations do not occur in the tropical regions, except under certain xerotic conditions where aestivation may occur associated with cessation of reproductive activity. While extensive work has been done on the study of reproductive cycles of rodents, the same attention has not been paid to the study of reproduction of the lower primates, especially the Lemuroidea. There is some suggestion of a restricted breeding season in many of the lower primates, and of some varying intensity in the higher



primates (Asdell<sup>1</sup>). The paucity of information on the reproduction of this interesting group is probably due to the difficulty of obtaining adequate numbers of animals through the year. It is essential that this lacuna should be filled as a means of providing links in the reproductive behaviour between the lower primates and the higher primates on the one hand and the other mammalian groups on the other. It is with this object in view that a systematic study of the reproduction in the male slender loris, *Loris tardigradus lydekkerianus* has been undertaken. Loris were collected from the forests within a radius of about 25 miles from Bangalore between December 1941 and May 1945.

Loris breeds twice a year, one or occasionally two young being born in late April or May and again in November or December; young have been produced in captivity as late as June (Hill<sup>2</sup>).

Hill<sup>3</sup> suggested that the male experienced two heat periods and that the abdominal testes became scrotal overnight, and the scrotum was affected by a reticular pigmentation. On the basis of this observation, Ramaswami and Anand Kumar<sup>4</sup> point out that the testes should descend and become scrotal during March-April and September-October when mating occurs. They did not observe any case of complete descent of the testes into the scrotal sacs in any of the animals maintained in their colony. Our observations based on collections from the wild state show that the testes are either inguinal, or abdominal and do not usually descend, more than temporarily into the scrotum. Activity of the males as determined by the presence of sperms in the seminiferous tubules, epididymes and ductus deferens extends throughout the year with no sign of regression during any season.

Our collection reveals that the weight of the testes can be taken as a fair index of sexual activity. The testes weights range from 0.013 to 3.465 gm. In testes weighing between 0.013 and 0.062 gm. the seminiferous tubules are in an immature state. A large number of closely packed spermatogenic tubules full of spermatogonial cells is characteristic of this stage. In those with testes weights ranging from 0.072 to 0.180 gm. traces of central lumen are visible and the primary and secondary spermatocytes are in various stages of division. Spermatogenic activity commences when the testes weigh about 0.760 gm. The testes with weight over 0.900 gm. are functionally active and their tubules are full of spermatozoa. Func-

tional testes may be abdominal, inguinal or scrotal in position. It appears therefore that the descent of the testes into the scrotal sacs is not very necessary for its normal working.

The growth of the accessory glands of reproduction is closely correlated with the growth of the testes. All show linear correlations with the weight of the testes.

Ramaswami and Anand Kumar<sup>4</sup> state that the penis functions normally when the testes are suprascrotal (inguinal?) but not when the latter are mechanically forced into the scrotum. The anatomical position of the scrotum and the penis precludes this suggestion. Further this statement which is not supported by adequate experimental evidence needs to be verified.

A more detailed paper on the correlations between the testes and the accessory glands of reproduction will be published elsewhere.

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M. R. N. PRASAD.

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# HISTOCHEMICAL OBSERVATIONS ON CHITIN IN THE FORMATIVE STAGES OF THE ENDOCUTICLE OF *CINGALOBOLUS BUGNIONI*, A DIPLOPOD

ADULT cuticles of *Cingalobolus bugnioni* give typical chitosan colour reaction in the endocuticle turning violet with iodine-sulphuric acid indicative of chitin.<sup>1</sup> But in the endocuticle of juveniles the chitosan test unlike in the adult condition gives an orange colour. It is known that only chitin will survive the chitosan treatment in saturated potassium hydroxide at 180° C. for an hour and give a violet colour reaction with iodine-sulphuric acid. The material in question also survives such treatment in potassium hydroxide at 180° C. and gives a colour reaction, though the colour is orange instead of violet.

A positive periodic acid-Schiff reaction may indicate the presence of chitin.<sup>2</sup> Runham<sup>3</sup> identified chitin in the newly formed radula

of *Patella* by the application of PAS test. In *Cingalobolus* also the endocuticle of the juveniles are positive to PAS. That the reactive substance may be a carbohydrate is suggested by the results obtained with PAS after pyridine extraction of the cuticle which had no effect on the intensity of the PAS reaction and from the observation that sections treated with PAS after methylation following deamination, to block acid and amino-groups, are still positive in the endocuticle.<sup>4</sup> Identical results have been obtained with the endocuticle of adults. However, after pretreatment with saliva the PAS reaction is less intense in the endocuticle of juveniles whereas in the adults such treatment does not affect the intensity of PAS reaction. The above-mentioned observation may suggest that in the adult endocuticle a glycogen-like substance is absent though present in the juveniles. Since chitin is known to be a polymer of N-acetyl-D-glucosamine,<sup>5</sup> it is suggested that in the developing cuticle the chitin synthesis may not be complete so as to leave some of the constituents of chitin chemically reactive. If so, the orange colouration obtained in the chitosan reaction in the cuticle of juveniles may be due to such differences in the chemical nature of chitin.

In this connection it is of interest to note that an orange chitosan colour similar to that reported above has been obtained in the epicuticle of *Palamneus* by Krishnan *et al.*<sup>6</sup> The above authors who also studied the X-ray diffraction patterns of the epicuticle suggested that the substance in question may be of the nature of chitin. Presumably the epicuticular chitin of *Palamneus* is similar to that indicated by the orange chitosan colouration in the developing endocuticle of *Cingalobolus*.

My grateful thanks are due to Professor G. Krishnan for his kind encouragement and valuable guidance. I am indebted to the authorities of the University of Madras for the award of a studentship.

Department of Zoology, G. SUNDARARAJULU.  
Madras University Extension Centre,  
Madurai-2, July 2, 1962.

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## MODIFICATIONS OF THE TECHNIQUE FOR DETERMINATION OF CHLOROPHYLL STABILITY INDEX IN RELATION TO STUDIES OF DROUGHT RESISTANCE IN RICE

THE chlorophyll stability index (C.S.I.) was correlated with drought resistance in pine needles and in rice seedlings by Koleyoreas (1958) and Sahadevan (1961) respectively. These workers derived the term C.S.I. by determining the difference between the colorimetric readings of the chlorophyll extract from heated and unheated leaf samples. Koleyoreas (*l.c.*) determined the C.S.I. in pines by heating 5 gms. of the leaf sample in 50 ml. of water at  $56^{\circ} \pm 1^{\circ}$  C. in a water-bath for  $\frac{1}{2}$  hour and extracted the chlorophyll with 100 ml. of acetone (4 : 1). Sahadevan modified the technique in rice seedlings by reducing the leaf sample to 2 gm. and extending the period of heat treatment to  $1\frac{1}{2}$  hours. In a series of experiments at the Central Rice Research Institute, Cuttack, the authors felt the necessity for further modification of the technique while dealing with leaf samples of rice collected at tillering and pre-flowering stages. The modifications are reported in the following experiments.

*Experiment I.*—Leaf samples (2.5 gm.) of eight well-known upland varieties were heated at  $56^{\circ}$  C. and  $65^{\circ}$  C. for  $\frac{1}{2}$  hour and extracted with 50 ml. of acetone (4 : 1) before recording the readings on the colorimeter. The C.S.I. of these varieties is presented in Table I.

TABLE I

Variety	C.S.I. at	
	$56^{\circ}$ C.	$65^{\circ}$ C.
W. 454	.. 1	12
W. 418	.. 2	6
W. 794	.. 0	6
W. 691	.. 2	11
B 76	.. 1	21
Mtu. 17	.. 2	2
Ac-511	.. 0	9
W. 398	.. 0	10

Table I shows that the varietal differences were much amplified at  $65^{\circ}$  C. than at  $56^{\circ}$  C. and this amplification of fine shades of differences may be very useful for easier interpretation of the data.

Further experimentations in this study were guided by the considerations: (a) Can the amount of leaf sample be further reduced in order to deal with even small samples? (b) Can the acetone be used more economically? (c) What is the optimum duration of heat treat-

ment. In a series of preliminary experiments, the authors observed that 1 gm. of fresh leaf sample was sufficient for the determination of C.S.I., and the quantity of acetone (4 : 1) could be reduced to 40 ml. for the extraction of chlorophyll. The water required for soaking the sample could also be reduced to 25 ml.

*Experiment II.*—In order to determine the optimum duration of heat treatment required for determination of C.S.I. in rice, one gram leaf samples from a variety Co. 13 were heated for  $\frac{1}{2}$  to  $1\frac{1}{2}$  hours both at  $56^{\circ}\text{C}$ . and  $65^{\circ}\text{C}$ . The results of this experiment are given in Table II.

TABLE II

Duration of heat treatment	C.S.I. at	
	$56^{\circ}\text{C}$ .	$65^{\circ}\text{C}$ .
$\frac{1}{2}$ hour	4	10
1 "	8	20
$1\frac{1}{2}$ "	10	24

Table II shows that one hour heat treatment at  $65^{\circ}\text{C}$ . would be optimum for determination of C.S.I. in rice.

*Experiment III.*—In this experiment, the C.S.I. values of two wet land varieties, Co. 13 and Adt. 19, and two reputed drought resistant varieties, Mtu. 17 and W. 371, were determined to see the differences between these two sets of varieties. The data are presented in Table III.

TABLE III

Variety	C.S.I. at	
	$56^{\circ}\text{C}$ .	$65^{\circ}\text{C}$ .
Co. 13	6	10
Adt. 19	7	10
W. 371	1	2
Mtu. 17	1	1

Table III shows that wet land varieties had relatively higher C.S.I. values than the drought resistant types.

From the foregoing results, the modified technique for determination of C.S.I., in rice, can be summarised as follows :

One gram of fresh leaf sample is soaked in 25 ml. of water and heated at  $65^{\circ} \pm 1^{\circ}\text{C}$ . for 1 hour in a water-bath. The material is then extracted with 40 ml. of acetone (4 : 1) in a waring blender for 5 minutes, filtered through No. 1 filter-paper and colorimetric (Klett Photoelectric) reading of the filtrate is taken using No. 66 Red filter. Similar reading from an unheated sample is taken as control. The difference between these two readings is designated as C.S.I. of the variety concerned.

Thanks are due to Dr. R. H. Richharia, Director, for his help in the present investigations.

Central Rice Res. Institute, K. S. MURTY.  
Cuttack-4, (Orissa), S. K. MAJUMDER.  
May 28, 1962.

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### A PROMISING MUTANT IN RICE BY RADIOACTIVE PHOSPHORUS

In a previous communication the senior author reported the occurrence of a dwarf mutant by subjecting paddy seeds to different doses of beta rays. In recent years a large number of mutants by the irradiation of the seeds by X, gamma and beta rays are reported. It is often the experience that a large majority of mutants have not proved economically useful. Recently Jagathesan, Bhatia and Swaminathan (1961) reported a beneficial mutant of wheat by the development of awns on an improved awnless variety of wheat N.P. 799 which has also recorded higher yield than the original N.P. 799. The mutant is recently released as a new variety N.P. 836. The utilization of X-ray radiation for rice improvement was reported by Hu *et al.* (1960) for obtaining erectoids, early maturing and disease-resistant types. They were able to isolate two erectoids, three non-shattering types and some early maturing types. They have also reported higher yields with the mutants than in the original variety. In a biometrical study of irradiated populations of rice Kua Nan Kao *et al.* (1960) suggested that the selections should be made in  $X_3$  lines. Further, a dosage of 25 Kr. of X-ray for dormant rice seeds is recommended to obtain the highest heritability value in  $X_3$  lines. Mohanty (1960) studied the effects of radioactive phosphorus and sulphur on growth, morphological characters, somatic cell division, pollen and seed fertility on paddy. Even trace doses like  $5\mu\text{c}$ . and  $10\mu\text{c}$ . of isotopes produced effects on cell division in paddy. Such plants flowered eight days earlier than the control.

In the present investigation the authors subjected 100 seeds of an improved variety of paddy—T. 1145 with phosphorus—32,  $500\mu\text{c}$  for 24 hours. The seeds were treated in the Bose Institute, Calcutta, in January 1957. Later they were sown in pots. Though they flowered normally towards the end of April, the seed-setting was poor. They were harvested towards the end of May. The  $M_2$  and  $M_3$  generations were grown in 1957 and 1958 at Bripada

and the subsequent generations at the Agricultural Station, Sambalpur. Two selections P 500-28 and P 500-4 made in  $M_2$  generation appeared to be very promising. The mutants differed from the original variety in several characters as shown in Table I. The nature of grains, and the earhead are shown in Figs. 1 and 2.

The results of the yield tests during 1960-61 and 1961-62 are given in Table II.

From Table II, it may be seen that P 500-28 has given consistently higher yield in both the years.

Ministry of Food and Agri.  
Krishibhavan,  
New Delhi-1,  
May 16, 1962.

G. V. CHALAM.  
J. S. NANDA.  
S. N. MALICK.  
R. K. TRIPATHI.

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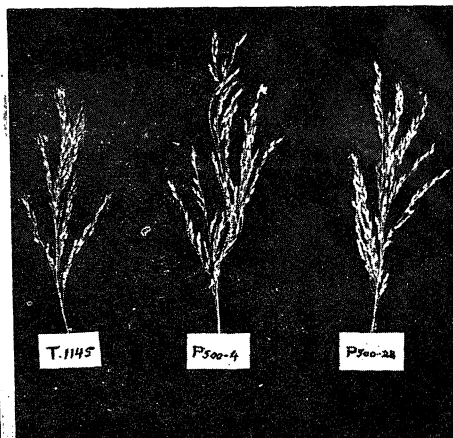
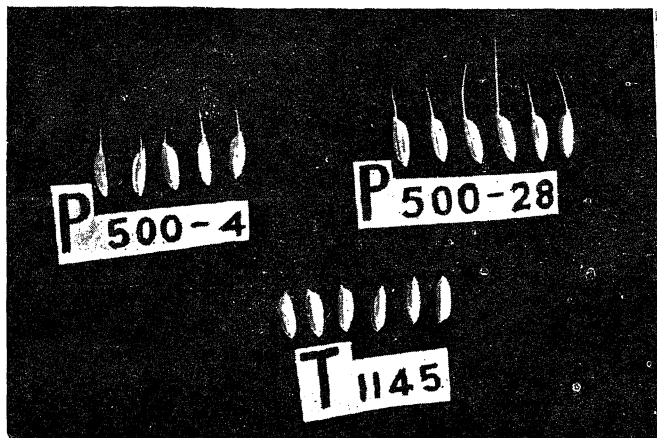


FIG. 1.

FIGS. 1-2. Fig. 1. Spikelets of mutants and the original variety.

FIG. 2.

Fig. 2. Earheads of the mutants and the original variety.

TABLE I

Mutants	Height in inches	No. of tillers at the time of flowering	No. of tillers at the time of harvest	Days taken for flowering	Panicle		Colour of the 'spikelet	Awn	Apicule colour	Stigma colour	Grain colour	Grain quality
					Length cm.	No. of grains						
P 500-28	150	7	6	106	26.0	230	Fawn	Awned	White	White	White	Fine
P 500-4	149	8	5	109	28.0	225	Fawn	Awned	White	White	Dull white	Fine
T 1145	148	8	5	110	23.0	185	Dirty brown	Not awned	Purple	Purple	Dull white	Coarse

TABLE II

Mutants	Straw to grain ratio	100 grain wt. in gm.	Yield of grains in lb./acre	
			1960-61	1961-62
P 500-2-10-2-8	2 : 1	2.12	3115	3217
P 500-2-12-13-4	3 : 1	1.93	2574	1835
T 1145	3 : 1	2.21	2753	1564
		C.D. 5%	465	315

Our thanks are due to Dr. D. M. Bose, Director, Bose Institute, Calcutta.

#### A NOTE ON THE INCIDENCE OF STEM-BORER (*SCHOENOBIVS* *INCERTULAS* WLK.) ON BORO PADDY UNDER NITROGEN FERTILIZERS

GREATER damage to rice crop by stem-borer when the crop receives nitrogenous manures and fertilizers has been reported in Japan<sup>1</sup> and China.<sup>2</sup> It has also been recorded in Central Rice Research Institute, Cuttack,<sup>3</sup> that the incidence of stem-borer was more in plots receiving high doses of nitrogen as ammonium

sulphate. This greater incidence might be due to greater succulence of the foliage. Ghosh<sup>4</sup> has observed a good correlation between stem-borer incidence and water content of the stem and leaf. The present note deals with observations on the incidence of stem-borer in rice variety, "Chinsurah boro-1", in relation to manurial treatments and water content of stem and leaf.

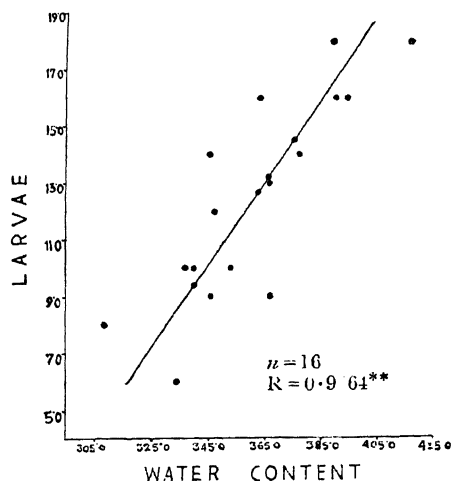
Observations were taken on the incidence by collecting and counting the larvæ every week in February 1960 from the damaged plants in each of the 4 replications of a manurial experiment with 4 treatments. The experiment was conducted at the Rice Research Station, Chinsurah, with a randomised block design. Organic manure as mustard cake and inorganic manure as ammonium sulphate had been added, singly and in combination, during final puddling at the rate of 100 lb. nitrogen per acre. Water content of stem and leaf as percentage of dry weight and plant height were also recorded.

The data presented in Table I show clearly that the incidence as determined by the

TABLE I

Stem-borer incidence and manurial treatment in rice

Treatment	No. of larvæ per plant	Height (cm)	Water content of stem and leaf
Control	9.5	94.3	340.2
Mustard cake	12.0	113.5	365.9
Ammonium sulphate	15.0	116.2	374.9
Mustard cake + Ammonium sulphate	13.3	108.9	362.5



number of larvæ is highest in plots receiving ammonium sulphate where the plant height and water content of stem and leaf are also the highest. The differences in the incidence due to treatments are found significant. The data also show a high and significant correlation between number of larvæ and water content of stem and leaf (Fig. 1), confirming the previous findings of Ghosh.

The results would indicate that the application of nitrogenous fertilizers definitely increases the succulence of stem and leaf as revealed by greater water contents and such succulence leads to greater incidence of the stem-borer.

It is now to be seen how far the experimental plots escape the attack of *Schœnobia* by growing simultaneously the tall and succulent varieties of paddy around the border of the experimental plots as guard rows.

The author is grateful to Dr. H. K. Nandi, Director of Agriculture, West Bengal, and to Shri A. K. Paul, Head of the Economic Botany Section, for their keen interest, and to Shri P. B. Chatterjee, Entomological Research Assistant, for his help in this work.

Rice Research Station,  
Chinsurah, West Bengal,  
May 18, 1962.

B. N. GHOSH.

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#### OCCURRENCE OF BRUSH ORGANS IN *CORCYRA CEPHALONICA* STANTON (GALLERIDAE, LEPIDOPTERA)

BRUSH ORGANS have been observed on the coxæ of the hind legs in the male rice moth, *Corcyra cephalonica* Stainton. These secondary sexual structures appear to be of frequent occurrence and are long known (2 and 3) to function as scent-producing organs of considerable importance in successful mating. Eltringham<sup>1</sup> has published histological details of the brushes and associated glands in some moths and butterflies.

In *Corcyra* male moths the brush organs (Fig. 1) are present on the swollen meron of

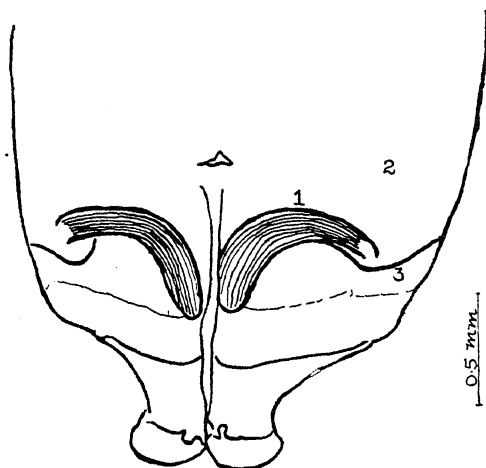


FIG. 1. 1. Brush organ; 2. Meron; 3. Chitinous arch.

each hind coxa posteriorly, and are easily overlooked amongst the scales, being closely approximated to the invaginated anterior portion of the first abdominal segment containing the tympana. Each brush is attached at the base under an invaginated fold of the cuticle in the middle region of the meron, and consists of an expansible tuft of numerous long hairs which run inwardly and bend downwards at half their length forming a right angle. The brush expands at the lower free end, when the coxa is touched laterally with a pin, but immediately springs back again to its original position parallel to the long axis of the body. Apparently the brush expands by the action of its extrinsic muscles. Attached to the base of the brush and extending outwardly is a chitinous arched structure, which with its muscle fibres, may serve to contract the brush. The hairs of the brush are striated and take a deep stain (Mallory's).

Detailed studies of the structure and functioning of the brush organs are in progress.

Grateful thanks are due to Dr. M. Putta-rudraiah, Government Entomologist, for guidance, and to Dr. S. W. Mensinkai, Principal, for encouragement.

College of Agriculture and S. USMAN.  
Research Institute, Krishinagar,  
Dharwar, March 15, 1962.

# **SUSCEPTIBILITY OF THE KHAPRA BEETLE: TROGODERMA GRANARIUM EVERTS TO OXYGEN DEFICIENCY AND INCREASED CO<sub>2</sub> CONCENTRATION IN THE AIR**

THERE is practically no information available on the susceptibility of the Khapra beetle, *Trogoderma granarium* to air that is deficient in oxygen but contains more of CO<sub>2</sub>. Baily (1955)<sup>1</sup> observed that in the case of *Calandra granaria* L., 100% mortality of all the stages required an increase of CO<sub>2</sub> to 40% or a decrease of oxygen to 2%. According to this author, death was due to depletion of oxygen caused by respiration of the insects and grains that were held airtight, and not due to the accumulation of CO<sub>2</sub> although the presence of the latter had a little additional effect. In the present work some preliminary studies have been made on the mortality of the various stages of the Khapra beetle, *Trogoderma granarium* when exposed to air of five different compositions containing oxygen, CO<sub>2</sub> and nitrogen in the following proportions, viz., (a) 17%, 17% and 66%; (b) 13.6%, 33% and 53.4%; (c) 10.2%, 50% and 39.8%; (d) 6.8%, 67% and 26.2% and (e) 3.4%, 83% and 13.6%. The various stages were exposed to the above five gas mixtures for 24, 48 and 72 hours.

The studies were carried out in 500 c.c. closed flasks in which the various stages of the pest (one hundred each of egg, larva, pupa and adult) were separately put and later the flasks were filled with the required amounts of CO<sub>2</sub> by creating the necessary vacuum. The CO<sub>2</sub> was obtained from a cylinder containing the gas. A set of controls was also kept for the above experiments in which the various stages of the pest were subjected to the same vacuum strain and then kept closed in the flasks for similar times after bringing back the stages to normal atmospheric pressure. During and after the exposure the various stages were kept at a constant temperature of 35° C. and observations were taken for a period of 72 hours in the case of the adults and 15 days in the case of the larvae. The eggs and the pupae were under observation for such time till further hatching of the eggs and emergence of the adults had ceased. The experiments were repeated twice to confirm the results.

These preliminary studies have indicated that the eggs are the most susceptible stage in so far as a decrease in the oxygen concentration and increase in CO<sub>2</sub> concentration in the atmospheric air is concerned. Observations

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showed that there was practically no hatching of the eggs when these were exposed to an atmosphere containing 13.6% of oxygen, 33% of CO<sub>2</sub> and 53.4% of nitrogen for 72 hours. There was about 50% mortality in the eggs when these were exposed to the above atmosphere for 48 hours. In the case of the adults and the pupæ, 100% mortalities were observed when these were exposed to an atmosphere containing 6.8% of oxygen, 67% of CO<sub>2</sub> and 26.2% of nitrogen for 72 hours. When exposed to the above atmosphere for 48 hours, the mortalities were 36% and 75% for the adults and the pupæ respectively. The larval stage was found to be the most resistant stage and an appreciable mortality in this stage (approach-

brown margin scattered all over the leaf. These spots show abundant formation of round black, tiny fruiting bodies. The central part of the leaf-spots becomes thin, papery and often falls away leaving a shot-hole effect.

#### IDENTITY OF THE FUNGUS

Although two species of *Phyllosticta* have been reported on species of *Sapindus*, viz., *P. raimundi* Sacc. on *Sapindus* sp. and *P. sapindi* P. Henn on *Sapindus saponaria* L., none has been, so far, described on *Sapindus emarginatus* Vahl., which is typically a tropical plant. A careful comparison was, therefore, made of the three species, the results of which are presented in Table I.

TABLE I

Comparison of species of *Phyllosticta* reported from *Sapindus* species

Fungus	Host	Pycnidia in $\mu$	Pycnidiospores in $\mu$	Authority
<i>Phyllosticta sapindi</i> P. Henn	<i>Sapindus saponaria</i> L.	70-100	6 × 2-5	P. Henn* (1902)
<i>P. raimundi</i> Sacc. ..	<i>Sapindus</i> sp.	60-70	3 × 2-3	Saccardo (1931)
Poona species ..	<i>Sapindus emarginatus</i> Vahl.	92.4-168.0	5.25-7 × 2.1-3.15	..

\* Less quoted from Saccardo, 1906.

ing 50%) was observed only when the larvæ were exposed to an atmosphere containing 3.4% of oxygen, 83% of CO<sub>2</sub> and 13.6% of nitrogen for 72 hours.

Division of Entomology, P. B. MOOKHERJEE.  
I.A.R.I., New Delhi,  
May 1, 1962.

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#### A NEW *PHYLLOSTICTA* LEAF SPOT OF *SAPINDUS EMARGINATUS* VAHL. FROM INDIA

DURING the cold season of 1961 the writer noticed a severe leaf-spot disease on *Sapindus emarginatus* Vahl., popularly known as Soapnut tree growing at Ganeshkhind Fruit Experiment Station (Poona). The disease attracted special attention due to its severe nature and the great economic importance the tree occupied in India both as substitute for soap and in medicine.

Critical examination of the fungus in sections as well as in culture showed formation of abundant globular pycnidia and pycnidiospores and was later identified as a species of *Phyllosticta*. The disease manifests itself in the form of small, circular spots, with an ashy-white to brown centre surrounded by dark-

The fungus under study thus possesses much bigger pycnidia besides being collected on a new economic host and is therefore presented as new species with Latin diagnosis.

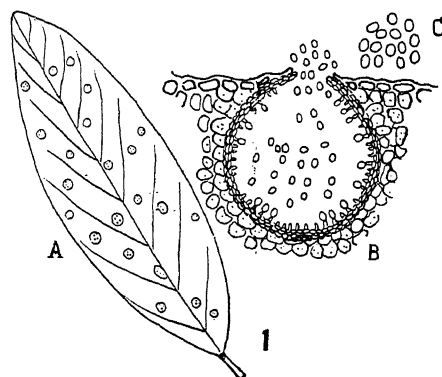


FIG. 1. *Phyllosticta sapindi-emarginati*, A, Symptoms, × ½ natural size; B, Section of Pycnidium, × 132; C, Pycnidiospores, × 220.

*Phyllosticta sapindi-emarginati* Vasant Rao spec. nov.

Infectionis maculæ amphiphyllæ, uniformiter circulares, dispersæ per totam folii paginam, cinereo-albæ in medio, fusce brunneæ ad margines. Pycnidia amphiphylla, fusce brunnea, ostiolata, globularia, suberumpentia, 92.4-168.0  $\mu$ . Conidia unicellularia, hyalina, ovoidea, 5.25-7 × 2.1-3.15  $\mu$ .

In foliis viventibus *Sapindi emarginati* Vahl.  
Leg. Vasant Rao mense decembri, 1961, ad  
Poona in India, M.A.C.S. Herb. No. 116.

The type material is being deposited in Herb.  
Orientalis, New Delhi, India and Herb. C.M.I.,  
Kew, England.

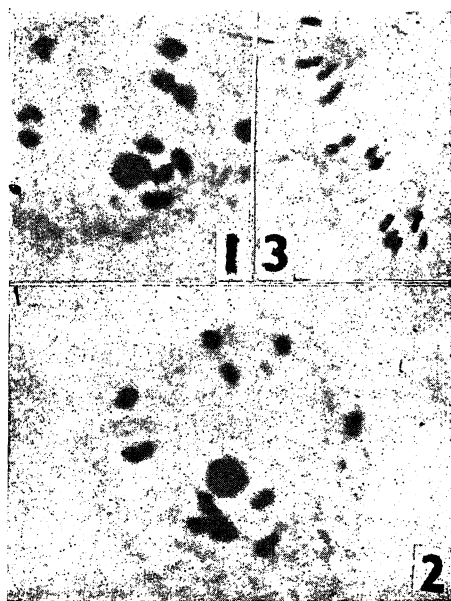
The author's grateful thanks are due to  
Prof. M. N. Kamat for his guidance and to  
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Agricultural Research, New Delhi, for the  
award of a Senior Research Fellowship.

M.A.C.S. Labs., VASANT GURUNATH RAO.  
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### CHROMOSOME NUMBER IN *SALVADORA PERSICA* L.

THE family Salvadoraceæ includes three genera,  
*viz.*, *Azima*, *Dobera* and *Salvadora* (Willis<sup>1</sup>).  
The two common species of *Salvadora* are  
*S. persica* and *S. oleoides*. *S. persica*, an ever-  
green shrub or small tree with a short and  
crooked trunk, flourishes well on saline soils  
along with *Capparis aphylla* and *Prosopis*  
*spicigera*.<sup>2</sup>



FIGS. 1-3. Fig. 1. Diakinesis showing 12 II. Fig. 2.  
Diakinesis showing secondary association between four  
bivalents. Fig. 3. Metaphase I showing 12 II. All  
figures,  $\times 3,360$ .

A perusal of the literature (Darlington and  
Wylie,<sup>3</sup> Chandrasekharan *et al.*<sup>4</sup>) reveals that  
no cytological studies have so far been con-  
ducted on any member of the family. The  
present note puts on record the chromosome  
number of *Salvadora persica*.

Flower-buds were pretreated with .002 M sol.  
of 8-Hydroxyquinoline before their fixation in  
1:3 acetic alcohol. Ordinary acetocarmine  
squashing technique yields satisfactory results.  
At diakinesis 12 pairs of contracted and deeply  
stained chromosomes are found scattered all  
over the sporogenous cell (Figs. 1 and 2). Two  
of these bivalents keep associated with the  
spherical, well-stained nucleolus. Though  
presence of a single nucleolus appears to be  
the rule, cells with two nucleoli are frequent.  
The supernumerary nucleolus is smaller and  
remains adpressed to the main nucleolus or the  
two keep quite apart. In such cells one bivalent  
was found attached to each nucleolus. Several  
well-spread metaphase plates showing 12 II  
were available after pretreatment (Fig. 3).  
Anaphase I is regular and results in the distri-  
bution of 12 chromosomes to each pole.

The authors are grateful to Principal R. K.  
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ing*, 1960.

### CHROMOSOME NUMBERS OF SOME INDIAN GRASSES

THE present note records the chromosome  
numbers of thirteen species of grasses collected  
mostly from Sagar (Madhya Pradesh). They  
are either new reports or different from the  
earlier ones and in eight cases confirm the  
previous reports.

The voucher specimens of all the species have  
been deposited in the Herbarium at Forest  
Research Institute, Dehra Dun, U.P., India.

The writer is grateful to Dr. Y. Sundar Rao  
for his guidance, to the Indian Council of



S. No.	Species	n	2n	Author
1	<i>Andropogon pumilus</i> Roxb.	.. 10	.. 20	This note Krishnaswamy, 1934 <sup>3</sup>
2	<i>Apluda aristata</i> Linn.	.. 10	.. 20	This note Hunter, 1934 <sup>3</sup>
		..	..	Joseph, 1955 (unpublished)
		..	40	Avdulov, 1928 <sup>3</sup>
3	<i>Chionachne koenigii</i> (Spreng.) Thw.	.. 10	.. 20	This note Mangelsdorf, 1939 <sup>3</sup>
		..	..	Janaki Ammal, 1934 <sup>3</sup>
4	<i>Coix lacryma jobi</i> Linn.	.. 5	.. 10	This note Joseph, 1955 (unpublished)
		..	20	Mangelsdorf and Reeves, 1939 <sup>3</sup>
5	<i>Dichanthium annulatum</i> (Forsk.) Stapf.	.. 10	..	Celariet <i>et al.</i> , 1958 <sup>1</sup>
		20	..	
		30	..	
		..	20	Mehra, 1955 <sup>2</sup>
		40	..	
	As <i>Andropogon annulatus</i> Forsk.	.. 20	.. 20	Gould, F. W., 1956 <sup>2</sup>
		10	..	This note
		..	40	Karper and Chisholm, 1936 <sup>3</sup>
		..	..	Janaki Ammal, 1945 <sup>3</sup>
		..	..	Joseph, 1955 (unpublished)
6	<i>Phalaris minor</i> Retz.	.. 14	.. 18	This note Parthasarathy, 1939 <sup>3</sup>
		14	28	Hansen and Hill, 1953 <sup>2</sup>
		..	29	
7	<i>Ischaemum rugosum</i> Salisb.	.. 10	.. 18	This note Celariet and Harlan, 1956 <sup>2</sup>
		..	..	
8	<i>Iseilema antheophoroides</i> Hack.	.. 3	..	This note
9	<i>Iseilema laxum</i> Hack.	.. 14	..	do.
		14	..	Joshi <i>et al.</i> , 1959 <sup>4</sup>
		..	36	Ramanathan, 1950 <sup>3</sup>
10	<i>Mnesithea laevis</i> (Retz.) Kth.	.. 7	..	This note
11	<i>Rottboellia exaltata</i> Linn.	.. 20	.. 36	Moffett and Hurcombe, 1949 <sup>3</sup>
		..	..	Krishnaswamy <i>et al.</i> , 1954 <sup>3</sup>
		20	..	This note
12	<i>Thelepogon elegans</i> Roth.	.. 5	.. 10	do.
		..	..	Joseph, 1955 (unpublished)
13	<i>Tripogon</i> sp.	.. 12	..	This note

Agricultural Research for the financial assistance and to Shri M. B. Raizada, Head of the Botany Department, Forest Research Institute, Dehra Dun, for the identification of the specimens.

Department of Botany, T. N. V. RAMANA RAO.  
University of Saugar,  
Sagar (M.P.), India,  
May 28, 1962.

#### ONTOGENY OF PELTATE PALEAE IN THE POLYPODIACEAE

THE nature of the epidermal appendages of ferns, the hairs and paleae, have long been recognised as an important criterion in assessing the phylogeny and relationship of the advanced ferns.<sup>1</sup> A possible correlation between the characteristic trichomes of the gametophytes of the advanced ferns, and the paleae and hairs of sporophyte has also been suggested by some workers.<sup>2</sup> No critical study of the sporophytic trichomes, however, seems to have been made, though the gametophytic trichomes appear to have attracted considerable attention in recent years.<sup>3-7</sup>

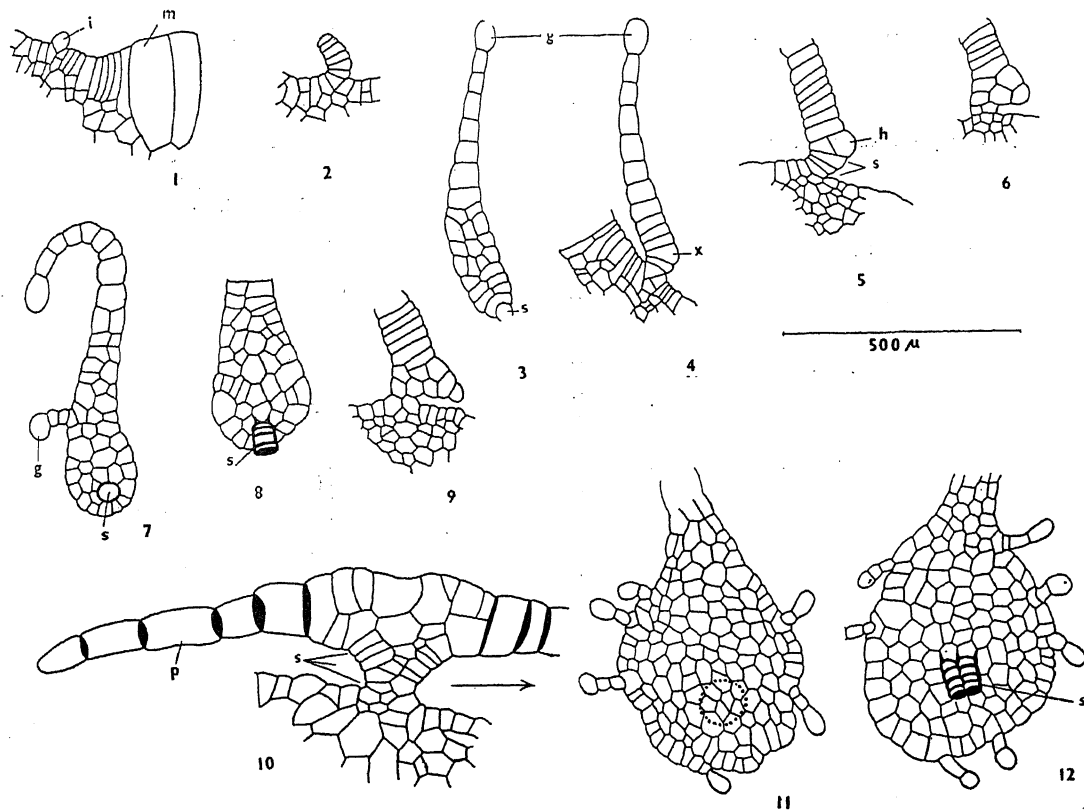
During the course of detailed morphological studies of some of the Polypodiaceae, it became apparent that the peltate paleae of many of the genera like *Arthromeris*, *Crypsinus*, *Drymoglossum*, *Drynaria*, *Microsorium*, *Pleopeltis* and *Pyrrhosia* develop in a characteristic way. The

1. Celariet, R. P. Mehra, K. L. and Wulf, M. L., *Brittonia*, 1958, 10 (2), 59.
2. Carnahan, H. L. and Helen, D. Hill, *Bot. Rev.*, 1961, 27 (1), 1-162.
3. Darlington, C. D. and Wylie, A. P., *Chromosome Atlas of Flowering Plants*, George Allen & Unwin Ltd. (London), 1955.
4. Joshi, A. B., Patil, B. D. and Manchanda, P. L., *Curr. Sci.*, 1959, 28 (11), 454.
5. Joseph, J. "Cytological Studies in Gramineae of Saugar," *Unpublished M.Sc., Thesis, University of Saugar, Saugar, 1955.*

following is a short account of the development pattern.

The paleæ originate from the dermal cells close to the meristem, generally those next to the apical meristematic cone of the rhizome. A wedge-shaped small palea initial is cut off towards the outer surface of the mother cell by means of a wall oblique to the radial wall on the side facing the apical cone of rhizome. This initial cell protrudes out as papilla (Fig. 1)

like cells towards the base, and elongated barrel-shaped cells towards the apex. The terminal cell of the hair soon enlarges, becomes globose or pyriform (Fig. 3, *g*) acquiring dense cytoplasmic contents and a larger nucleus. Soon it stops growth and the contents become brownish. Meanwhile the hair bends towards the apex of the rhizome, by unilateral elongation of the side-wall of the cell, generally 1-3 cells away from the base of the hair (Fig. 4).



FIGS. 1-12. Fig. 1. L.S. of a portion of the apex of the rhizome of *Crypsinus hastatus* showing the apical meristematic cell (*m*) and the palea initial (*i*). Fig. 2. L.S. of young palea of the same. Fig. 3. Surface view of a young palea of *Drymaria sparsisora* showing broadening of basal region and uniseriate stalk. Fig. 4. L.S. of the same showing attachment of palea to the rhizome and unilateral elongation of one of the basal cells (*x*). Fig. 5. L.S. of the basal region of the young palea of *Crypsinus hastatus* showing formation of a hood cell (*h*) and elongation of stalk (*s*). Fig. 6. L.S. of same showing enlargement of hood. Figs. 7-8. Surface view (ventral) of the young palea *Microsorium scolopendria* showing peltate attachment of stalk due to formation of a hood-like basal region. Fig. 9. L.S. of the basal region of the palea at nearly the same stage of development as that in Fig. 8. Fig. 10. L.S. of mature palea of *Crypsinus hastatus* showing attachment of stalk (*s*) and the posterior region (*p*) of the palea (the arrow points to the apex of palea). Figs. 11-12. Basal region of young peltate palea of *Microsorium scolopendria* showing attachment of stalk (*s*) and marginal hair (Fig. 11—dorsal view; and Fig. 12—ventral view).

which is later cut off by a transverse wall. The papilla grows out and by means of successive transverse divisions forms an elongated uniseriate hair (Fig. 2) which tapers towards the apex. The hair is composed of broad disc-

The two or three basal cells below the curved cell constitute the stalk, and during development forms the more or less cylindrical massive stalk of the palea. The portion of the hair anterior to the stalk develops into the body of

the palea. These cells especially those towards the stalk repeatedly divide longitudinally bringing about lateral expansion of the body of the palea, which soon becomes lanceolate, but one cell thick throughout. The curved wall of the basal cell of the body of the palea now bulges out as a hood-like protuberance over the stalk. The protruded region is cut off by a vertical wall formed in a plane perpendicular to the broad axis of the palea, so that at this region the palea is two cells thick (Fig. 5). The 'hood' cell (Fig. 5, h) protrudes out and by anticlinal and periclinal divisions forms a multicellular smooth-margined ridge (Figs. 5-8). This ridge expands and develops into the posterior region of the mature palea. The palea, during development, becomes two cells thick at the region where the stalk is attached to the body (Figs. 6, 9), but remains one cell thick in the other regions. No specialised meristem is ever formed during development. Towards maturity some of the marginal cells of the palea, especially at the peltate basal half, grows out to form uniseriate, two or more cells long, slender hairs (Figs. 11, 12). The terminal cells of these hairs become swollen and acquire dense granular contents which become brownish on the mature palea. The stalk of the mature palea (Fig. 12, s) is more or less cylindrical and gradually tapering downwards. It is usually two to three cells thick at the base and four to eight cells thick at the apex, where it is attached to the body of the palea.

In most of the species studied, mature palea are clathrate. The thickening of the walls initiates in the anterior cells of the palea and spread gradually downwards towards the stalk. When the basal peltate region of palea is developed the thickening starts in the posterior marginal cells and gradually spreads backwards towards the stalk of the palea.

The author wishes to express his thanks to Prof. K. N. Kaul for the keen interest and to Dr. B. K. Nayar for his help and guidance.

Pteridology Laboratory, PRAKASH CHANDRA.  
National Botanic Gardens,  
Lucknow, April 6, 1962.

1. Christensen, C., *Verdoorn's Manual of Pteridology*, 1938.
2. Nayar, B. K., *Sci. and Cult.*, 1956, 21, 455.
3. —, *Lloydia*, 1960, 23, 102.
4. —, *J. Indian bot. Soc.*, 1961, 40, 164.
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# **BELTRANIELLA HUMICOLA SP. NOV.**

IN the course of studies on the distribution of microfungi in cultivated, uncultivated and forest soils of Hyderabad (Andhra Pradesh), a species of *Beltraniella* Subramanian<sup>1</sup> was isolated from the soils of Narsapur forest (Medak District). The fungus was found to differ sharply from *Beltraniella odinæ* Subramanian,<sup>1</sup> the single species so far described, in having smaller conidia, much longer and narrower setae with lateral branches restricted to 1-3 basal cells and some sterile setae. Therefore, the fungus under study is described as new species.

*Beltraniella humicola* SP. NOV. RAMARAO

Coloniae bene expansae in agrao sucroso solanaceo, primo albæ, tum evadentes pallide griseo-virides et ætate provecta fusciore, serie stromatica; conidiophori setis similes, ramulos laterales ferentes; axis erectus, rectus, uniformis, fastigatus in apicem acutum vel rotundatum, usque ad 14-septatus, crassis parietibus, rarissime unico ramulo laterali, magnitudinis variæ 85.0-292.5  $\mu$  et 2.5-3.8  $\mu$  lati; setae steriles raræ; ramuli pallidiores quam axis, surgentes e cellulis 1-3 basalibus axis sub ipsa septa, ferentes ramulos laterales multoties forcatos, ramulis ultimis supportantibus conidia, magnit. variæ, 2.5-3.8  $\mu$  lat. Conidia acrogena, producta singulariter insidentia cellulis fusiformibus vel oblongo-ellipticis 'separantibus'; cellulæ 'separantes' conidiis pallidiores, magnit. 7.5-10.5  $\times$  2.3-3.5  $\mu$ ; conidia pyriformia, subhyalina vel pallide griseo-brunnea, ornata zona pallidiori ad medium, unicellularia, fixa per apices acutos, decidua, 15.5-22.5  $\times$  6.2-8.5  $\mu$ .

Ex silva decidua et ex Zeæ campo.

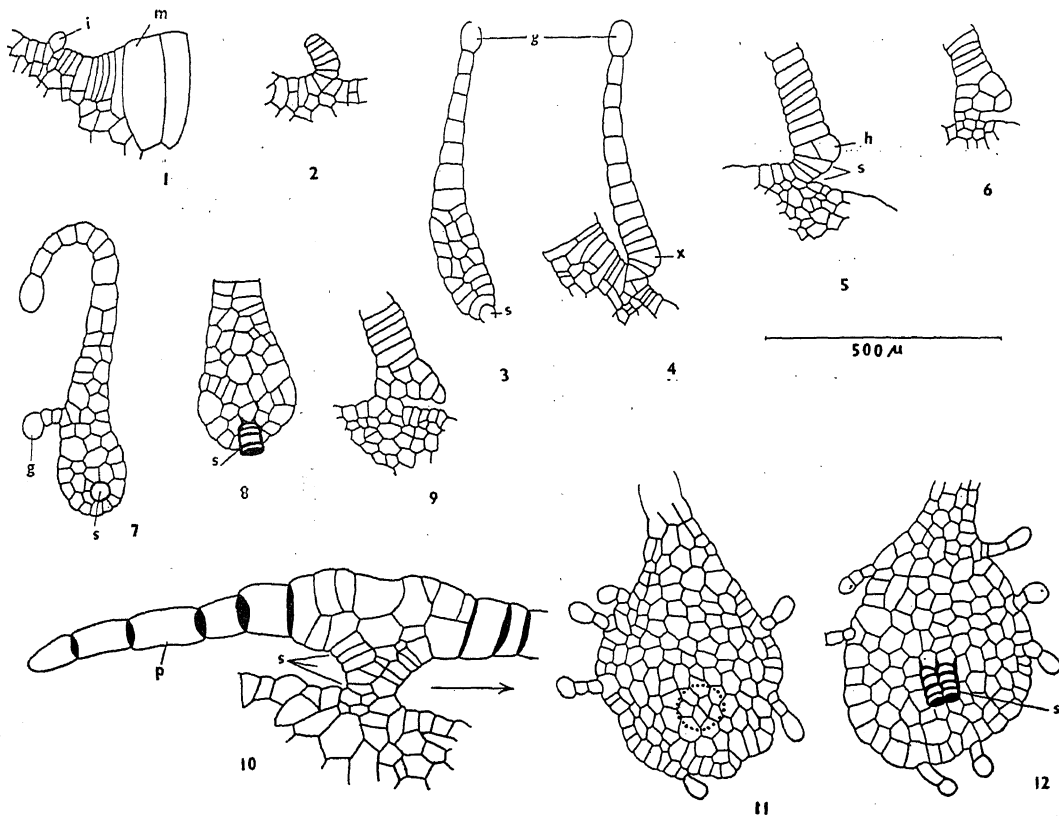
*Beltraniella humicola* SP. NOV. RAMARAO

Colonies of the fungus spreading well on potato sucrose agar, white at first turning pale grey green, becoming darker with age, with blackish stromatic layer; conidiophores with seta-like main axis bearing lateral branches; axis erect, straight, uniform, tapering to a rounded or pointed apex, up to 14-septate, thick-walled, very rarely with a side branch, variable in length, 85.0-292.5  $\mu$  and 2.5-3.8  $\mu$  broad; sterile setae occurring rarely; branches paler than the axis, arising from 1-3 basal cells of the axis just below the septa, giving rise to much branched laterals, the ultimate branch bearing the conidia, variable in length, 2.5-3.8  $\mu$  broad. Conidia acrogenous, produced singly on fusiform or oblong-elliptic 'separating cells'; separating cells paler than conidia, measuring 7.5-10.5  $\times$  2.3-3.5  $\mu$ ; conidia top-shaped, sub-

following is a short account of the development pattern.

The paleæ originate from the dermal cells close to the meristem, generally those next to the apical meristematic cone of the rhizome. A wedge-shaped small palea initial is cut off towards the outer surface of the mother cell by means of a wall oblique to the radial wall on the side facing the apical cone of rhizome. This initial cell protrudes out as papilla (Fig. 1)

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National Botanic Gardens,  
Lucknow, April 6, 1962.

1. Christensen, C., Verdoorn's *Manual of Pteridology*, 1938.
2. Nayar, B. K., *Sci. and Cult.*, 1956, **21**, 455.
3. —, *Lloydia*, 1960, **23**, 102.
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5. —, *Bull. Nat. Bot. Gard.*, 1961, **58**, 1-38.
6. Stokey, A. G., *Phytomorphology*, 1951, **1**, 39.
7. —, *Amer. Fern J.*, 1960, **50**, 78.

# *BELTRANIELLA HUMICO.*

IN the course of studies on the microfungi in cultivated, uncultivated soils of Hyderabad (Andhra Pradesh) of *Beltraniella* Subramanian<sup>1</sup> was the soils of Narsapur forest (M. The fungus was found to differ from *Beltraniella odinae* Subramania species so far described, in its conidia, much longer and narrower, lateral branches restricted to 1-3 some sterile setae. Therefore, this study is described as new species.

*Beltraniella humicola* SP. NOV.

Coloniae bene expansae in solanaceo, primo albæ, tum evadunt griseo-virides et ætate provecta stromatica; conidiophori setis simplicibus laterales ferentes; axis erectus, rectus fastigatus in apicem acutum versus usque ad 14-septatus, crassis parvis sime unico ramulo laterali, magnitudine 85.0-292.5 µ et 2.5-3.8 µ lati; setae ramuli pallidiores quam axis, cellulis 1-3 basalibus axis subferentes ramulos laterales multo ramulis ultimis supportantibus color variae, 2.5-3.8 µ lat. Conidia acrogena singulariter insidentia cellulis fusiformia oblongo-ellipticis 'separantibus'; conidia rantes' conidiis pallidiores, magnitudine 2.3-3.5 µ; conidia pyriformia, subpallide griseo-brunnea, ornata zona media, unicellularia, fixa per apicem decidua, 15.5-22.5 × 6.2-8.5 µ.

Ex silva decidua et ex Zeæ campis.

*Beltraniella humicola* SP. NOV. F.

Colonies of the fungus spreading on potato sucrose agar, white at first, pale grey green, becoming darker with blackish stromatic layer; conidia with seta-like main axis bearing 1-3 lateral branches; axis erect, straight, uniform to a rounded or pointed apex, up to 14-septate, thick-walled, very rarely with a side branch; variable in length, 85.0-292.5 µ long and 2.5-3.8 µ broad; sterile setae occurring rarely; paler than the axis, arising from 1-3 basal cells of the axis just below the septa, giving much branched laterals, the ultimate bearing the conidia, variable in length, 2.3-3.5 µ broad. Conidia acrogenous, produced singly, fusiform or oblong-elliptic 'separating' separating cells paler than conidia, measuring 15.5-22.5 × 6.2-8.5 µ; conidia top-shaped.

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hyaline to light greyish-brown in colour with a paler band in the middle, 1-celled, attached by their pointed ends, deciduous,  $15.5-22.5 \times 6.2-8.5 \mu$ .

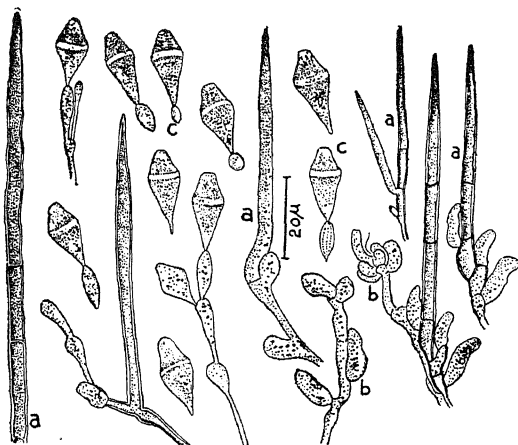


FIG. 1. *Beltraniella humicola* sp. nov. a, seta; b, lateral branch; c, conidia.

Isolated from a deciduous forest and a maize field soil.

The type culture is being deposited in Indian type culture collection of Fungi, Division of Mycology and Plant Pathology, I.A.R.I., New Delhi.

The author expresses his thanks to Dr. M. A. Salam, Head of the Department of Botany, for help and encouragement and to Rev. Father Prof. H. Santapau for the Latin diagnosis of the species.

Department of Botany,  
Osmania University,  
Hyderabad, June 9, 1962.

P. RAMARAO.

1. Subramanian, C. V., "Fungi Imperfecti from Madras. III. *Beltraniella*, gen. nov.," *Proc. Indian Acad. Sci.*, 1952, **36B**, 223.

#### A NOTE ON THE CHEMICAL EXAMINATION OF THE TUBERS OF *KAEMPFERIA ROTUNDA*, LINN.

ALTHOUGH it has been known that the tubers of *Kaempferia rotunda*, Linn. have important medicinal properties,<sup>1</sup> so far no systematic chemical examination has been reported except a very early work<sup>2</sup> on the essential oil content of the same. So we have presently undertaken

an investigation of the non-essential oil portion of the drug collected from South Kerala.

The powdered air-dried tubers of *Kaempferia rotunda*, Linn. when Soxhleted with petroleum ether (60-80) gave a white crystalline solid in 0.4% yield, apart from an essential oil portion. The compound (C = 60.01% and H = 4.59%) after repeated crystallisations from methanol melted at 149-50°C. Further purification on a column of alumina using benzene as solvent did not alter the melting point. The molecular weight determination by Beckmann's lowering of freezing point method in benzene solution gave an approximate value of 350. On heating with 2N Sodium Hydroxide solution on a boiling water-bath for about half an hour, the substance dissolved giving a green colouration which then turned to bluish-green, dark-green and finally dark-brown. Benzoic acid could be isolated from the hydrolysed mixture after acidifying it with concentrated Hydrochloric acid. Also the compound was found to have reducing properties with alkaline Potassium permanganate, Fehling's Solution and Tollen's Reagent. But it did not decolorise bromine-water, nor could it be acetylated with acetic anhydride and pyridine. Similarly carbonyl reagents like Hydroxylamine hydrochloride 2, 4-dinitrophenyl hydrazine and semicarbazide hydrochloride did not show any tendency to yield a condensation product with the compound.

The ultra-violet spectrum of the substance shows an absorption maximum at 2300 Å and is without further peaks up to 3250 Å. The infra-red spectrum shows strong absorption bands at  $1760 \text{ cm.}^{-1}$ ,  $1265 \text{ cm.}^{-1}$ ,  $1110 \text{ cm.}^{-1}$  and  $1370 \text{ cm.}^{-1}$  and a number of other weak bands.

Further work is in progress.

The authors acknowledge with thanks the help rendered by Prof. T. R. Govindachari, Presidency College, Madras, for the results of the micro-analysis and infra-red spectra of the compound. One of us (P. M. Pillai) is thankful to the Council of Scientific and Industrial Research for the award of a Junior Research Fellowship to him.

Dept. of Chemistry,  
University College,  
Trivandrum, October 27, 1962.

P. MADHAVAN PILLAI.  
N. S. WARIYAR.

1. Chopra, R. N., Nayar, S. L. and Chopra, I. C., *Glossary of Indian Medicinal Plants*, C.S.I.R., New Delhi, 1956, p. 147.
2. Ber. Schimmel u. Co., *Lpz.*, April 1894, p. 58.

## REVIEWS

**Lectures on Field Theory and the Many-body Problem.** Edited by E. R. Caianiello. (Academic Press, New York and London), 1961. Pp. xiii + 327. Price \$ 9.50.

During the last decade, a large number of papers have appeared on the mathematical techniques relating to many-body systems, which find applications in diverse fields of physics such as field theory, metal physics, atomic and molecular physics and superconductivity. The activity in this field has been so phenomenal that the many-body problem has presently gained a position as a separate discipline in theoretical physics.

The book under review is a collection of lectures delivered at the First International Spring School of Physics held at the University of Naples. The contributors to the volume are among the leaders in their fields. The first chapter by G. Luders deals with the TCP theorem and related problems. In quantized field theory, the type of statistics obeyed by particles is related to the commutation relations between field operators, and the author here discusses the connection between spin and statistics, the TCP theorem and other problems encountered in elementary particle physics. Chapters two to six again are devoted to field theory and amongst the various topics discussed here are unstable particles, propagators in electrodynamics and dispersion relations. Chapter seven by J. G. Valatin deals with second quantization and configuration space method. This chapter will especially be useful for those working in molecular quantum mechanics because it brings out the close relationship between the configuration space method and field quantization through the use of Grassman algebra. In another chapter, the same author gives a brief survey of his work in superconductivity.

An important development in many-body problem in recent years is the use of graphs, analogous to the Feynman graphs, to describe the different terms of the perturbation series. The graphical method which was developed by Goldstone and Hugenholtz finds wide applications in correlation problems as well as in Brueckner's theory of the compound nucleus, and the method has been surveyed in the book

by L. Van Hove in the chapter entitled "Ground State Theory of Many-Particle Systems".

A principal defect of the book is that the different chapters are so brief and incomplete that they will hardly be useful to a beginner to learn the subject. Otherwise the topics treated in the volume represent a wide spectrum of problems in physics and will be welcomed by all workers in the many-body problem.

K. S. VISWANATHAN.

**Mathematisches Wörterbuch—Mit Einbezeichnung Der Theoretischen Physik.** By Josef Naas, Hermann Ludwig Schmid. (Pergamon Press Ltd., Headington Hill Hall, Oxford), 1961. Band I, A-K, Pp. xi + 1043; Band II, L-Z, Pp. vi + 952.

This impressive publication, viz., the *Dictionary of Mathematics* (in German) has been sponsored jointly by the Institute of Pure Mathematics and the German Academy of Sciences, Berlin. It is a co-operative effort to which more than 125 experts have contributed. The result is that we have in this *Dictionary* an authoritative source book of reference on the applications of mathematical techniques in relation to theoretical physics.

Mathematical techniques as tools to solve physical problems have always been recognized, and the progressively growing importance of these techniques—to which many new ones have been recently added—in the advancement of modern theoretical physics cannot be over-emphasised. In fact, Mathematical Physics has become a separate subject by itself in post-graduate courses and many universities have separate Faculties also for this subject. The use of Mathematical Techniques has invaded not only fundamental sciences but also engineering and technology.

Thus there has been felt a need for a compendium of the nature envisaged in the preparation of this "Word-book". It is not a dictionary in the ordinary sense. Besides, comprehensive definitions of terms, important theorems and lemmas are also given, and their applications to diverse problems are indicated. Several terms dealt with in the Dictionary form complete articles by themselves. At the end of

each definition, wherever necessary, references to literature on the subject are indicated.

The *Dictionary* also contains brief biographical sketches of celebrated mathematicians and their achievements.

The printing and get-up are excellent and the binding is strong to stand constant use. It is hardly necessary to add that no library should be without these two volumes of the *Dictionary of Mathematics*.

A. S. G.

**Probability and Experimental Errors in Science—An Elementary Survey.** By L. G. Parratt. (John Wiley and Sons, Inc., New York; India: Asia Publishing House, Bombay-1), 1961. Pp. xv + 255. Price \$ 7.25.

Statistics is the science of distribution. It is a mathematical philosophy based on logical reasoning and not subject to experimental verification. In its broad scope, the subject forms a complex branch of higher mathematics, which seems to lie beyond the reach of the average engineer and physical scientist.

Scientific knowledge is based on observed fact. Every measurement, however, is subject to experimental error and, as such "absolute truth, i.e., the theory of Nature" can be discerned only by estimating the error in the data obtained from the rather limited observations. To achieve scientific maturity, the experimenter should recognize the existence of this error and must learn to qualify his results by a careful analysis of the reliability of his measurements. This self-appraisal becomes realistic when it is based on probability theory. Thus statistics serves as a "lens which brings science into a philosophical focus". It is an all-inclusive concept which underlies every intellectual discipline which deals with quantitative relationships—physics, engineering, medicine, biology, economics, commercial business, sociology, to name but a few. For a student of any quantitative science, the importance of an early understanding of this theory cannot be overemphasised.

The book, written by a Professor of Physics at Cornell University, aims to instil into the Science and Engineering undergraduate this basic discipline. Starting with a discussion of quantitative probability, with examples from gambling games, the author orients the study towards the consideration of experimental information. He emphasises that each observation is but a random sample of the possible values. He shows how the methods of statistics could

be applied to determine the degree of uncertainty in the results. He discusses the maximum likelihood estimate, the propagation of errors, curve fitting and data smoothing. Also analysed are data with Gaussian and Poisson distributions.

The discussion is more practical than mathematical and is intended for the scientist rather than the statistician. It deals with only the fundamentals of statistics and concentrates on the application of the formulæ to scientific solutions. Numerous well-chosen problems, many with answers, supplement the text. However the beginner would need much assistance in developing his 'intuition' to answer these problems. Some further numerical examples in the text would ease this difficulty. As it is, the book is more likely to be popular with the staff than with the student. The basic formulæ discussed in the text are collected together in a useful glossary. The text is well indexed and gives many references for collateral reading.

PREM J. BHAT.

**Eighth Symposium (International) on Combustion.** (Published for the Combustion Institute by the Williams and Wilkins Company, Baltimore), 1962. Pp. xxviii + 1164. Price \$ 31.

The great expansion one finds in combustion research during the past decade or two is a natural consequence of the demand of a rapidly growing propulsion industry. Airborne propulsion industry, especially, imposes exacting conditions of technical development.

Theoretical or fundamental research on problems of combustion is one thing, and the application of the results of this research to practical problems connected with combustor design is an entirely different thing. Whereas researchers work on idealized systems engineers have to work on experience based on actual design conditions. There is great need for the two to meet in order that effective means of achieving maximum efficiency consistent with the practical limitations may be arrived at. This series of symposia have been organized by the Combustion Institute exactly for that purpose.

The Eighth International Symposium on Combustion was held at the California Institute of Technology, Pasadena, California, from August 28 to September 2, 1960. More than 600 scientists and engineers from all parts of the world participated at the symposium. In addition to 9 invited papers, 124 contributed papers were presented. All these papers are published in this large volume.



The technical papers presented at the symposium show significant progress on many interesting basic problems such as laminar-flame theory, the theory of spray combustion, nozzle-flow studies with chemical reactions, relaxation processes behind shock fronts, detonation of solids, and mechanism of production of ions in flames.

The 124 papers have been divided broadly under the following heads: chemical kinetics, ions in flames, combustion spectroscopy, shock waves and relaxation phenomena, nozzle-flow, laminary and turbulent flames, detonations and explosions, ammonium perchlorate propellants and solid propellants, engine combustion problems, solid-fuel and liquid-fuel rocket engines.

Containing as it does the latest results and information on various topics of combustion and combustion engineering, this publication will be welcomed by all those who have anything to do with combustion both academically and from the technical and industrial point of view.

A. S. G.

**Valency and Molecular Structure.** 2nd Edition. By E. Cartmell and G. W. A. Fowles. (Butterworths, London), 1961. Pp. xii + 294. Price 32 sh. 6 d.

Among several texts available as an introductory volume to the subject of valency and molecular structure, "Cartmell and Fowles" has been one of the most popular, as is well borne out by the six impressions it has had since the first edition was published in 1956. The remarkable clarity in presentation, without loss of precision in language, is one of the attractive features of the book. The volume under review is the second edition incorporating considerable revision in many sections, notably Parts II and III.

Part I of the book is essentially unchanged and deals with quantum theory and atomic structure. A short section at the end of the first chapter in this part gives useful correlation between the various energy units commonly employed. The relation between spectroscopic, thermal and electrical units are illustrated by listing the numerical values of the energies corresponding to radiation at three different wavelengths.

The largest change occurs in Part III where a new section on ligand field theory has been introduced. Part III deals primarily with the application of bonding principles to representative organometallic and inorganic compounds. The concept of crystal field stabilisation energy is presented in lucid style. The reactivity of

complexes is included as a special section. How much up-to-date this section is, will be evident from the fact that 26 out of the 93 references are to the literature published in 1960.

The book has an attractive get-up and is free from typographical errors. The diagrams are well integrated with the text. The price continues to be the same as before although the size has increased by some forty pages more. The book deserves to be in the personal libraries of students of chemistry—at all levels.

B. S. THYAGARAJAN.

**Metabolic Pathways, Vol. II.** Edited by David M. Greenberg. (Academic Press, New York and London; India: Asia Publishing House, Bombay-1), 1961. Pp. xiii + 814. Price \$24.00.

The volume under review is the second edition of an earlier publication entitled *Chemical Pathways of Metabolism* and consists of articles on various aspects of amino-acids, proteins, nucleic acids, heme and water-soluble vitamins.

The first four chapters deal with nitrogen metabolism and carbon catabolism of amino-acids as well as amino-acid biosynthesis and the metabolism of sulphur-containing compounds. Various aspects of deamination, transamination and deamidation of amino-acids have been discussed as also the overall catabolism of the carbon moiety of the amino-acids. There is also a very comprehensive survey of the biosynthetic aspects of not only the amino-acids but also the related biologically active compounds such as choline, epinephrine and thyroxine.

In the next chapter on the synthesis of proteins, I. D. Raacke has very lucidly dealt with all the available evidence on the subject and concludes that "the adenylate pathway of amino-acid incorporation is neither obligatory nor the most important one". He has expressed many thought-provoking ideas, one such being that "protein breakdown may be an energy-requiring process and may actually proceed by a reversal of all or part of the synthetic process".

The article on purines and pyrimidines has been written by M. P. Schulman while the one on nucleotides and nucleosides is by L. Warren, dealing with various biosynthetic aspects as also a detailed comparison of the microbial and the mammalian systems. S. Granick and D. Mauzerall have in their chapter on metabolism of heme and chlorophyll dealt with chemical and metabolic aspects and have reviewed

the recent advances on the biochemical lesions in porphyrin metabolism.

The concluding four chapters have been devoted to a critical study of a few water-soluble vitamins. Thiamine has been covered by P. Albersheim and J. Bonner, while N. O. Kaplan has written on metabolic pathways involving niacin and its derivatives. The biosynthesis of flavin derivatives has been dealt with by G. W. E. Plant while T. H. Jukes and H. P. Broquist have discussed the biogenesis and metabolism of folic acid and vitamin B<sub>12</sub>.

The volume undoubtedly is a mine of information and has many novel ideas and useful suggestions on various aspects of metabolic pathways. The printing and get-up of the book has been excellent, only two typographical errors having been noticed, one in p. 277, line 21, where 'though' should read 'thought' and in p. 648, where the title of third paragraph should read "Deamidation of nicotinamide".

Metabolic pathways to be more comprehensive should cover such topics as metabolism of trace elements, phosphorus compounds, pyridoxine and related compounds. It is to be hoped that Dr. Greenberg while revising this edition or while contemplating an additional volume will include the above topics as also recent information on vitamin D, photosynthesis-induced enzymes, charge transfer reactions and the like. However, the volume in the present form is of great value and should find a place in the bookshelf of every biochemist interested in various metabolic reactions.

P. S. SARMA.

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*Advances in Virus Research*, Vol. 8. Edited by Kenneth M. Smith and Max A. Lauffer. (Academic Press, New York and London), 1962. Pp. ix + 414. Price \$12.00.

The publication annually of the volumes of the *Advances in Virus Research* is eagerly looked forward to by virologists all over the world in view of the extremely authoritative and up-to-date reviews on selected subjects they generally contain. This 8th volume maintains the tradition of scholarship noted in the previous volumes and fulfils all expectations. There are eight articles written by the leaders in their respective fields, and are of varied interests ranging from such a fundamental theme as that of replication of T2 bacteriophage to such purely practical, nevertheless highly technical, matters connected with the plaque assay of viruses in tissue culture. The subjects selected reflect in a measure the wide diversity

of interests which go to influence the present-day science of virology. The articles, each of which is a masterpiece of its kind, included in the volume are:—

"Vegetative Bacteriophage and the Maturation of the Virus Particles" by Edward Kellenberger;

"The Replication of T<sub>2</sub> Bacteriophage" by Henry R. Mahler and Dean Fraser;

"Mumps Virus" by Kari Cantell;

"Clinical Syndromes Associated with Enterovirus and Reo Virus Infections" by T. F. McNair Scott;

"Factors in the Pathogenesis of Virus Diseases" by Frederik B. Bang and Charles N. Luttrell;

"The Cytopathic Effect of Animal Viruses" by H. G. Pereira;

"Contrast Enhancement in the Electron Microscopy of Viruses" by Robin C. Valentine; and

"The Plaque Assay of Animal Viruses" by P. D. Cooper.

Any publication of this kind has, of necessity, to choose a few subjects for inclusion in each volume, at the risk of having to exclude, for the time being at least, some of the other significant advances. In the 65 articles published since the first volume made its appearance in 1953 there has not been a single one dealing specifically with arbor viruses. Only five have indirectly dealt with viruses in relation to arthropods. It is hoped that this tremendously active field in virology will receive due attention in future issues.

T. RAMACHANDRA RAO.

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*A Text-Book of Zoology*, Vol. II (7th Edn.). By T. J. Parker and W. A. Haswell. (Macmillan and Co., Ltd., St. Martin's Street, London W.C. 2), 1962. Pp. xxiii + 952. Price 70 sh.

It is now more than sixty years since the first edition of this well-known text-book of zoology, 'Parker and Haswell' was published (1898). The successive editions up to the sixth (1940) appeared almost every ten years. The sixth edition in which Prof. Forster-Cooper made many changes went through four reprints between the years 1940 and 1961. The book has throughout been considered as indispensable among the zoological text-books for college teaching. There has been a need for a new and revised edition of this classical text-book.

Students of Zoology will remain indebted to Prof. Marshall for having undertaken the task of bringing out the seventh edition of the book. It is not simply a revised edition but one in

which much has been rewritten. As Prof. Marshall points out in the *Preface*, in this edition he has "attempted, within the limits of available space, to retain basic morphology and yet at the same time emphasise functional aspects and where possible, present animals as living creatures rather than as laboratory specimens".

An innovation in the present volume is the detailed captioning of the illustrations. All the elements of a classification are entered under each illustration of the animal. This will be of particular help to students to become familiarised with the animal's systematic position.

Every one will agree with Prof. Marshall that in order that a student may obtain a good understanding of living animals, both in form and in function, it is necessary that he should have adequate appreciation of the animal's ancestry. Accordingly in this edition palaeontology has been given due emphasis and the fossil sections have been expanded.

An added attraction to the book, which is profusely illustrated (659 figures), is a number of pen-drawings especially drawn for this edition by the artist Jane Marshall. A. S. G.

#### Introduction to Immunochemical Specificity.

By William C. Boyd. (Interscience Publishers, London), 1962. Pp. viii + 158. Price \$ 8.00.

The title explains the aim and scope of this small volume. The materials presented are based on a series of lectures given by the author at Moscow during 1959.

Keeping in view, the wider field of immunochemical specificity the topics covered include blood groups, plant antigens and microbial-immunological factors.

The first three chapters introduce the reader to the basic concepts of antigens and antibodies, their nature, specificity, chemical structure and formation. The current status of human blood groups, the significant role played by lectins or plant agglutinins in throwing light on the specificity of the blood group antigens and on the nature and number of carbohydrate groupings present on the surface of the erythrocytes are lucidly reviewed by the author.

The studies on the antigenic structure of several *Salmonella* species has to a large extent clarified the vagueness in the serological classification of *Salmonella*.

The last two chapters summarise the principal thermodynamic studies on the antibody-antigen reactions.

M. SIRSI.

*The Cell. Biochemistry, Physiology, Morphology*, Vols. II and III. Edited by Jean Brachet and Alfred E. Mirsky. (Academic Press, New York and London), 1961. Vol. II: Pp. xiv + 916. Price \$ 25.00; Vol. III: Pp. xiii + 440. Price \$ 12.00.

The volumes under review are parts of a well-integrated series viewing the Cell as a dynamic entity and attempting to correlate structure with function. The articles deal with the cell membrane, plant cell-walls, amoeboid movement, cilia and flagella, mitochondria, lysosomes, chloroplasts, Golgi apparatus, ground substance, interphase nucleus and its interactions with the cytoplasm (Vol. II), meiosis and mitosis. (Vol. III).

Written as they are by specialists, each article is authoritative and highlights the present situation. As the Editors themselves remark, Mazia's contribution on Mitosis is a *Magnum Opus*. The volumes would be invaluable to students of *The Cell*.

M. K. SUBRAMANIAM.

#### Books Received

From: (Addison-Wesley Pub. Co., Reading, Massachusetts, U.S.A.):

*The Mainstream of Physics*. By A. Beiser, 1962. Pp. xii + 468. Price \$ 7.00.

*Modern College Physics*. By J. A. Richards Jr., F. W. Sears, M. Russell Wehr and M. W. Zemansky, 1962. Pp. xvi + 1019, Price \$ 7.75.

*Hand-Book of Statistical Tables*. By D. B. Owen, 1962. Pp. xii + 580. Price 70 sh.

From: (Pergamon Press, Headington Hill Hall, Oxford):

*Table of Sines and Cosines to Ten Decimal Places at Thousandths of a Degree*. By H. E. Salzer and N. Levine, 1962, Price 70 sh.

*International Series of Monographs on Pure and Applied Mathematics* (Vol. 25)—*Generalized Analytic Functions*. By I. N. Vekua, 1962, Pp. xxix + 668. Price 105 sh.

From (Academic Press, Inc., 111 Fifth Avenue, New York-3):

*Blood Vessels and Lymphatics*. By David I. Abramson, 1962. Pp. xx + 812. Price \$ 26.00.

*Nuclear Science and Technology* (Vol. 2)—*Neutron Physics*. Edited by M. L. Yeater, Pp. xiii + 392. Price \$ 12.00.

*Advances in Agronomy* (Vol. 14). Edited by A. G. Norman, 1962. Pp. xi + 432. Price \$ 13.00.

*Elements of Indian Stratigraphy*. By S. K. Borooah. (Dattsons, Nagpur; Sole Distributors: The Western Book Depot, Nagpur), 1962. Pp. v + 207. Price Rs. 8.25.

## SCIENCE NOTES AND NEWS

### Award of Research Degrees

The Andhra University has awarded the Ph.D. degree in Physics to Shri T. A. Prasada Rao for his thesis entitled "The Structure of Electronic Spectra of the Monofluorides of Antimony and Bismuth".

Osmania University has awarded the Ph.D. Degree in Chemistry to Miss Syeda Begum for her thesis entitled "The Chemistry of Some s-Triazoles Derived from Semi-Carbazones and Hydrazones".

### Symposium on Alcohol Distillation

A Symposium on "New Developments of Chemical Industries Relating to Ethyl Alcohol, its By-products and Wastes", organized jointly by the All-India Distillers' Association and UNESCO South Asia Science Co-operation Office, will be held at the National Physical Laboratory, New Delhi, on January 19 to 23, 1963.

Following aspects of alcohol distillation will be discussed at the symposium; (1) Economy of energy means (Fuel, steam, cooling water, power); (2) Designing, construction and intensification equipment for production of ethyl alcohol and its by-products; (3) Automation and instrumentation; (4) Industrial utilization of alcohol and its by-products and wastes.

Further information in connection with the seminar can be obtained from; (1) Mr. J. Swarbrick, Director, UNESCO-SASCO, New Delhi, (2) Mr. O. N. Chandoke, Secretary, All-India Distillers' Association, H-37, Connaught Circus, New Delhi.

### Ford Foundation Grant to Delhi University

The Ford Foundation has made a grant of \$ 195,000 to the Department of Zoology, University of Delhi, India, for expanding the facilities for research and training in the field of Physiology of Reproduction over a five-year period. Dr. M. R. N. Prasad and Dr. B. R. Seshachar will be the chief investigators in charge of the programme. As part of the activity envisaged in the Ford Foundation grant, the Department of Zoology has organised a training programme consisting of a series of sixteen seminars on

Physiology of Reproduction in collaboration with Dr. Sheldon J. Segal, Consultant to the Ford Foundation on Reproductive Biology. The seminars are given by scientists from India and U.S.A. The seminar series which was inaugurated by Dr. C. D. Deshmukh, Vice-Chancellor, University of Delhi, on Monday, the 22nd October, 1962, will continue till the 25th February, 1963.

### Artificially Trapped Radiation Belt Produced by High Altitude Nuclear Explosion

A nuclear device in the megaton range was detonated in the ionosphere at an altitude of 320 kilometers in the vicinity of Johnston Island (16.7° N, 169.5° W) in the Pacific at 0900 U.T. on July 9, 1962. Prof. J. A. Van Allen *et al.* have presented a preliminary report of investigations made with the satellite *Injun I* of the artificial radiation belt produced by this high-altitude nuclear explosion (see *Nature*, 1962, 195, 939).

For every kiloton fission explosion in the device, there were produced about  $10^{23}$  fission nuclei the radioactive decay of which yielded some  $5 \times 10^{23}$  electrons of different energy range. Some of these electrons were injected at such pitch angles to the geomagnetic field vector that they were temporarily trapped, executing oscillatory motion in latitude along magnetic field lines and drifting eastward in longitude to form an artificial radiation belt encircling the Earth. This is the first reported case of a significant, artificial injection of durably trapped particles into the geomagnetic field since the *Argus* tests of 1958.

The present report is based on observations made with the State University of Iowa satellite *Injun I* which was designed for study of the naturally occurring radiation belts. It was launched on July 29, 1961, into an orbit with apogee 1010 km., perigee 890 km., inclination 67° and period 104 min. Three of the particle detectors in *Injun I* have supplied the data for the present study. Two of these detectors are directional (i.e., their response depends on the angle at which they point with respect to the magnetic field vector), and the third is omnidirectional thus providing the simplest means of mapping out the natural and artificial radiation zones,

Before the Johnston Island burst of July 9, 1962, the counting rates of the three detectors in the equatorial region were dominantly due to inner zone electrons and protons. After the event, there are three possible contributions: (a) from penetrating electrons from fission decay; (b) from decay products of neutrons produced in the explosion; (c) from a redistribution in space of naturally occurring trapped particles. The observed spectrum in equatorial regions seems to show that the dominant contribution is from penetrating fission-decay electrons.

Data also showed that one hour after the explosion the number of freshly injected and trapped electrons of energy  $E > 1500$  keV. in the geomagnetic field was of the order of  $10^{24}$ . The total mass of these particles which have created this intense radiation belt is therefore only of order 1 milligram.

A preliminary comparison of the *Explorer IV* data on the *Argus* (1958) shells with the present *Injun I* data on the Johnston Island shell shows that the intensity of particles in the present case was of the order of one thousand times as great.

It appears likely that the electrons artificially injected by the Johnston Island burst will continue to be present in measurable numbers for many months on the higher altitude-shells.

#### Light Source for Producing Self-Reversed Spectral Lines

It is well known that the presence of self-reversed spectral lines in the emission spectra of atoms greatly facilitates the problem of spectral analysis, as these lines provide valuable information regarding the ground state and other low-lying energy levels of the atom. It is also known that the spectra of rare-earth elements, besides being complicated, characteristically lack in lines of outstanding intensity and it is seldom that they show self-reversed lines even in arcs of moderate current strength. Increasing the current strength usually enhances self-reversals, but undue increase of current will generally melt the electrodes unless adequate cooling is provided.

In a paper contributed to the *Journal of Research* J. Sugar describes a convenient method for obtaining a cool, high-current arc. It consists of a pulsed arc discharge with a peak current of 75 amperes and an on-time of one millisecond per cycle. The device used as a spectral source produces numerous self-reversed lines in both the first and second spectra of rare-earth elements: TbI, YbI, YbII, TmI, TmII,

UI and UII. Resonance lines are nearly completely absorbed and can be distinguished by this character.—(Nat. Bureau Std., 1962, 66A, 321.)

#### Gallium Arsenide Diode Produces Infra-red Radiation

The Lincoln Laboratory of the Massachusetts Institute of Technology has announced recently a new solid state device which exhibits an "optical maser-like action", and converts electrical energy into infra-red radiation with remarkably high efficiency. The device, made of gallium arsenide and operated as a diode, emits an infra-red beam that can be focussed well enough to transmit signals over line-of-sight distances up to 50 kilometres. The beam intensity responds to variations in the input electrical signals as fast as 100 Mc./sec. With this band width it could accommodate 20 tv channels or 20,000 telephone circuits. When perfected, the diode will have important applications in communications.

The gallium arsenide diode does not emit coherent radiation. Nevertheless, the beam can be focussed sharply by conventional optical means. The wavelengths fall in a narrow band—about 100 Å wide—at a central frequency that depends on the operating temperature. It has been found that at 77° K. when the efficiency is highest, the central wavelength is about 8600 Å.

The diode is made by diffusing a spot of zinc on a piece of gallium arsenide the size of a pinhead. Current flowing through the junction raises electrons in the semiconductor to a higher energy level, and on returning to their original state and filling up the "holes" created by their absence, the electrons emit infra-red radiation.—(Sci. Amer., 1962, 207, 102.)

#### A New Ionospheric Ledge above the F<sub>2</sub> Region

Satellite *Ariel*, which was launched from Cape Canaveral on April 26, 1962, carried instrumentation to measure the local ionization density along the path of the satellite. These data are stored point by point along each orbit by a tape recorder on board the satellite, and relayed by fast play-back over the telemetry link on command from a ground station. *Ariel* is, therefore, the first satellite with instrumentation and a data-recovery system capable of providing a rapid world-wide survey of the distribution of ionization over the range of altitude and latitude covered by its orbit. This, in effect, means a scan of ionization between

latitudes  $54^\circ$  N. and  $54^\circ$  S. and in the geocentric altitude range of 400–1,200 km.

The electron or ionization density is measured by a new radio-frequency plasma probe which has been developed for ionospheric investigation. Significant new results have resulted from the analysis of a representative selection of the data. The following conclusions have been drawn from this analysis:

(1) The density of ionization above the  $F_2$  region of the ionosphere falls away with increasing altitude in the range of 400–1,200 km. (geocentric), generally on a world-wide scale according to approximate diffusive equilibrium in the earth's gravitational field.

(2) There are complex variations in the ionization density in this altitude-range, both temporal and geographical, which are comparable in relative magnitude to the corresponding variations in the  $F_2$  region.

(3) Superimposed on (1) and (2) there is very strong evidence for the existence of a further ledge of ionization at very much greater altitudes than  $F_2$ . This ledge has been observed regularly on a world-wide scale on every transit of the satellite through the altitude-range which has so far been analysed. This ledge appears as low as at 700 km. geocentric altitude during the day, and surprisingly at a higher altitude of 1,000 km. near local midnight.

A layer of ionization above the  $F_2$  region should be readily detected by a suitable topside sounder experiment using a high-altitude rocket or satellite. Such experiments have been reported by Knecht *et al.* (*J. Geophys. Res.*, 1961, 66, 3078 and 1962, 67, 1178) who recorded anomalous scatter echoes of large intensity at various altitudes in the range 700–1000 km. These effects, which were not at the time understood, seem to be consistent with the existence of a layer having deep spatial irregularities as is now revealed by the *Ariel* data.—(*Nature*, 1962, 195, 1143.)

### Origin of the Radio Emission from Jupiter

Since the first discovery of strong radio emission from the planet Jupiter by Burke and Franklin in 1955, a great deal has been learned about the characteristics of this radiation, and various suggestions have been made about its origin although none of them have been entirely satisfactory.

The chief facts about the Jovian radio emission are: (1) The radio bursts are intermittent (the rotational period of the sources agreeing with the accepted rotational period of the planet), and most of the energy is emitted in a narrow frequency range 10–35 Mc. with a maximum intensity at  $18 \pm 3$  Mc./sec. (2) The average intensity of a burst of radiation is about  $5 \times 10^{-21}$  watt. per sq. metre per cycle/sec. (3) The radiation is mainly right-handed circularly or elliptically polarized (an effect which suggests the existence of an intrinsic magnetic dipole field of Jupiter). (4) There is considerable evidence to show that the Jovian broadcasts are initiated by solar particles which travel from the Sun to Jupiter with travel times varying from 1 to 10 days.

Among the theories suggested for the origin of this radio emission are: (1) lightning discharges in Jupiter's atmosphere; (2) mechanism of plasma oscillation; (3) mechanism of synchrotron radiation from solar particles spiralling in Jupiter's magnetic field. But all these mechanisms have the drawback that one expects from them radio emission over a much broader frequency range than  $18 \text{ Mc.} \pm 3 \text{ Mc./sec.}$

A new suggestion for the origin of Jupiter's radio emission, which according to the authors explains the observed facts satisfactorily, has been put forward by Landovitz and Marshall. They suggest that this radio emission is a maser-like phenomenon, namely, is a decameter emission from electrons making spin-flip transitions in the perturbed magnetic field of Jupiter, and that furthermore the radio emission is stimulated as the perturbation travels through the ionosphere of Jupiter. It is suggested that impinging clouds of solar particles stimulate perturbations which in turn cause very sudden changes ( $\Delta H$ ) in the local magnetic field of Jupiter, in the time of the Larmor precession, so that the local population of electrons initially having an equilibrium distribution of spin orientation with respect to the local field direction is suddenly stimulated to make spin-flip transitions. The incidence of a cloud of solar particles, therefore, subjects an electron population in a static magnetic field to an oscillating magnetic perturbation causing the electron population to emit radiation at the Larmor frequency characteristic of the static field.—(*Nature*, 1962, 195, 1187.)

# LIGHT, COLOUR AND VISION\*

SIR C. V. RAMAN

I MUST thank the organisers for the honour of the invitation to address this Congress. I shall use the time at my disposal to dwell on the fundamental aspects of ophthalmology. We seek answers to the following questions. Firstly, what is the process by which our eyes are enabled to perceive light and colour? Secondly, what are the respective roles played by the retina and by the visual cortex in that process? It is obvious that the right answers to these questions can only be given if we understand correctly the physical nature of light and the manner in which it interacts with material bodies.

The nineteenth century physicists, notably Thomas Young, Hermann Von Helmholtz and Clerk-Maxwell who were interested in the problems of physiological optics were also the leading exponents of the wave-theory of light. That theory had many notable successes to its credit. Quite naturally, therefore, it was thought it could also form the basis for an understanding of the phenomena of vision. But this is not actually the case, for the concepts of the wave-theory of light are altogether irrelevant in relation to the interaction of light with material bodies. These interactions can be successfully described and understood only if it is recognised at the very outset that light consists of discrete units or quanta of energy. The interplay of light and matter is a process in which the quanta or energy-units in the radiation are transferred from the field to the material body or *vice-versa*. Unquestionably, therefore, the quantum theory is the proper basis for interpretation of the facts of visual experience.

The faculty that our eyes possess of perceiving colour brings the phenomena of vision into the closest relationship with the basic notions of the quantum theory. Light which appears as a sharply-defined line in the spectrum is composed of energy-quanta which are all equal. The quantum of energy varies with the position of the spectral line, being the lowest when it is at the red end and largest when it is at the

violet end of the spectrum. Thus, the magnitude of the energy quantum varies *pari passu* with the colour of the perceived light. Every one of the many different colours we can perceive in the spectrum has, therefore, an equal claim with all the others to be regarded as a primary colour and as a fundamental visual sensation. This was indeed the original view expressed quite clearly by Sir Isaac Newton in his celebrated treatise on Optics. The widely prevalent belief that there are only three fundamental colours or only three fundamental visual sensations has no rational basis.

The ability to recognise closely adjacent regions of the spectrum as being different in colour is a faculty that our eyes possess. The perceivable differences in colour correspond over extensive regions in the spectrum to very small differences in the energy of the associated light-quanta. This leads us to adopt a very simple view of the functioning of the retina, namely that it absorbs the incident light-quantum and retransfers the energy absorbed through the nervous pathways to the optical cortex. The question then arises, what are the light-absorbing pigments present in the retina which enable it to perform this function? What are the spectral regions in which these pigments respectively operate and how are they distributed over its area?

A technique for the investigation of the retinal processes has been devised by me which is of extreme simplicity but nevertheless yields highly interesting and significant results. The observer holds a suitably chosen colour filter in front of his eye and views an extended and brightly illuminated screen through the filter. After a brief interval of time, the filter is suddenly removed. What is then observed depends very much on the colour filter employed and especially on the part of the spectrum which the filter absorbs and the part which it transmits freely.

By way of illustration, it will suffice here to mention two strikingly contrasted cases. When a filter dyed with methyl violet which cuts out the yellow part of the spectrum around 5800 Å is held before the eye and then suddenly removed, the observer sees projected on the

\* Address to the XIX International Ophthalmological Congress, held at New Delhi, 3rd December 1962.

viewing screen a highly magnified picture in colours of his own retina in which the fovea and its central depression stand out conspicuously by reason of their differences in colour and brightness from the surrounding areas. On the other hand, when a filter dyed with eosine which shows an absorption band in the green around 5300 Å is put in and then removed, the screen presents the same appearance before the filter is put in and after it has been removed.

Using various colour filters, we can explore the entire spectrum from end to end by this technique. The result emerges that the visible spectrum can be demarcated into four sectors. The first sector is the part between the violet end and the wavelength at which the colour changes rapidly from blue to green. In the second sector, the visual luminosity of the spectrum increases progressively and reaches a maximum. In the third sector, the observed colour progressively changes from green to red. The fourth sector is the red end of the spectrum.

We now proceed to the identification of the materials present in the retina which function respectively in these four sectors. We shall take them in order.

Xanthophyll is the visual pigment which functions in the first sector and enables us to perceive the colours ranging from violet to blue. It is a yellow carotenoid pigment of vegetable origin which is present in all green plants and enters the human body through the medium of the food products consumed. It is present in the retina as the well-known yellow macular pigmentation. That it is indeed a visual pigment is indicated by the fact that the range of wavelengths in which the perceived colour changes very rapidly from blue to green is precisely the same as that in which the absorptive power of xanthophyll drops suddenly from a large value to zero. A further demonstration that xanthophyll functions as a visual pigment is furnished by the effects seen by an observer who views an extended source of light through a polaroid and a colour filter transmitting only the blue part of the spectrum. The observer sees an image of his own fovea projected against the source of light in which a bright brush and a dark brush appear crossing each other. This phenomenon is observed only when the illumination of the field is in the photopic levels and it disappears completely

when the brightness is reduced to the scotopic level. The brushes appear as a consequence of the shape and optical properties of the xanthophyll molecules. These orientate themselves parallel to the nerve fibres and hence are arranged radially in the foveal area. They absorb light and function as a visual pigment only in respect of vibrations parallel to the chain of eleven double bonds contained in the molecule.

Various considerations which cannot here be set out in detail serve to exclude the possibility of the visual pigments functioning in the three other sectors of the spectrum being carotenoids. The pigment which actually functions in the second or green sector of the spectrum is heme in which the iron atom located at the centre of the tetrapyrrolic group is in the ferrous state. Heme in the ferrous state exhibits a powerful absorption of light between 5000 Å and 6000 Å, the maximum of absorption being located at 5600 Å. The wavelength of maximum visual luminosity in the spectrum is also 5600 Å. Thus, by reason of its structure and spectroscopic behaviour, heme in the ferrous state fits perfectly into the role of the principal visual pigment. One more function is thus added to the many important roles which heme plays in the field of biology.

When the iron atom at the centre of the tetrapyrrolic group in the molecules of heme is in the ferric state, the absorption spectrum undergoes a radical change, the principal feature being an extension towards greater wavelengths and a greatly increased strength of absorption in the region between 6000 Å and 7000 Å. Thus, heme in the ferric state fits into the role of the visual pigment which functions in the fourth or red sector of the spectrum. The third sector in which the transitional colours of yellow and orange appear is clearly the part of the spectrum in which the ferrous and ferric states of heme function in co-operation with each other.

The time at my disposal does not permit of my dealing in detail with the problems of anomalous colour-vision. It will suffice here to state that the existence of such anomalies and their observed characteristics find a natural explanation on the basis of the present approach to the theory of vision. These and various other matters will be found discussed in detail in a memoir published by me two years ago,



## ANALYSIS OF BENZALDEHYDE IN THE PRESENCE OF BENZOIC ACID, BENZOQUINONE AND MALEIC ACID

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IN the course of investigations on the catalytic vapour phase oxidation of toluene, using vanadium pentoxide as the catalyst in a fluidized bed, the qualitative analysis of the mixture of reaction products obtained, indicated that it consists of benzoic acid, benzaldehyde, benzoquinone and maleic acid. Downie *et al.*<sup>1</sup> are reported to have analysed such a mixture using potentiometric and spectrophotometric techniques. However, when an attempt was made to analyse such a mixture using the well-known techniques of chemical analyses, certain difficulties were encountered. For instance, (1) the alkalimetric titration of the mixture, for the estimation of total acids, could not be employed, since benzoquinone produced a dark colouration with alkali; (2) the estimation of benzaldehyde by the oxime method<sup>4</sup> could not as such be used since this method involved ultimately the titration of hydrochloric acid liberated, against an alkali, and the presence of benzoquinone interferes in such a titration.

Solution (A) of a mixture of benzaldehyde, benzoic acid, benzoquinone and maleic acid was obtained in about 40 c.c. of ether. To solution (A), about 5 c.c. of 30% aqueous potassium iodide solution and a few drops of 30% sulphuric acid were added, and the mixture shaken well. Under these conditions, the benzoquinone present in the original mixture was quantitatively converted into hydroquinone, liberating an equivalent quantity of iodine.<sup>2</sup> The liberated iodine was primarily left in solution in the ether layer, and only a small quantity of it was left in the aqueous layer containing excess of unused potassium iodide. Known quantities of standard sodium thiosulphate solution were continually added to the reaction mixture until both the layers of the latter became colourless, indicating that sodium thiosulphate solution has been added in slight excess over that required to complete reaction with the liberated iodine. The resulting mixture was separated into a water layer (B) and an ether layer (C). Water layer (B) was titrated against standard iodine solution and the excess of thiosulphate present therein was determined. From the knowledge of the total amount of sodium thiosulphate added and its amount subsequently determined as excess, the amount of

iodine liberated and hence the amount of benzoquinone present in the original mixture was estimated on the basis that one mole of iodine liberated corresponds to one mole of benzoquinone.

The ether layer (C) contained benzaldehyde, hydroquinone (equivalent in quantity to that obtained from benzoquinone), benzoic acid and maleic acid. The benzoic and the maleic acid constituents of this solution were extracted into a saturated solution of sodium bicarbonate, obtaining thereby a layer of aqueous bicarbonate solution (D) containing the two acids, and an ether layer (E) containing benzaldehyde and hydroquinone.

The bicarbonate layer (D) was acidified with 30% sulphuric acid and treated with ether, when a water layer (F) and an ether layer (G) were obtained. At room temperature, since benzoic acid is highly soluble in ether and only very slightly so in water, the benzoic acid was completely extracted by ether, from a mixture of benzoic and maleic acids, together with a small amount of maleic acid, during one single extraction step with a relatively small quantity of ether. The major portion of the maleic acid however remained in solution in the aqueous layer (F), since it is highly soluble in water.

The ether layer (G) contained total benzoic acid present and a small quantity of maleic acid. By determining the total acid content of this layer by titrating it against standard alkali and then estimating its maleic acid content by titrating against standard potassium permanganate solution,<sup>3</sup> the quantities of benzoic acid and maleic acid present in layer (G) were determined.

Similarly, the quantity of maleic acid present in the aqueous layer (F) was determined permanganimetrically, and the total quantity of maleic acid present in layers (F) and (G) constituted the entire amount of maleic acid present in the original mixture.

The ether layer (G) contained benzaldehyde and hydroquinone, and the benzaldehyde was estimated from this mixture by the oxime method.<sup>4</sup>

Table I gives details of (1) the composition of the original mixture of benzoquinone, maleic acid, benzoic acid and benzal-

TABLE I

Component	Quantity in original mixture, g.	Quantity as estimated g.	% error
Benzoquinone ..	0.1096	0.1058	3.5
Maleic acid ..	0.2147	0.2062	4.0
Benzoic acid ..	0.4412	0.4263	3.4
Benzaldehyde ..	3.5053	3.4014	2.9

dehyde taken for analysis, (2) the amounts of the components as estimated by the analytical procedure reported above, and (3) the per-

centage errors involved in the various estimations. It was also observed that analytical errors of less than 1% were obtained for benzoquinone, when alcoholic solutions of the original mixture were iodometrically analysed.

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## NITRITE ESTIMATION IN THE ASSAY OF CERTAIN ENZYME SYSTEMS

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ASSAYS of nitrate and nitrite reductase systems are usually done by colorimetric estimation of the nitrite formed or lost during the reaction period by the Griess-Ilosvay method.<sup>1-4</sup> Hydroxylamine reductase may also be assayed by this method in terms of residual hydroxylamine recovered as nitrite, after oxidation. Two major sources of error may occur in these assays. The first of these is caused by a non-enzymic reaction between reduced pyridine nucleotides and nitrite<sup>1,5,6</sup> and the second by the underestimation of nitrite due to the precipitation of protein on adding the acid sulphanilamide reagent. The non-enzymic loss of nitrite was first reported by Evans and Nason,<sup>1</sup> who, however, considered it to be small. Medina and Nicholas<sup>6</sup> noted that nitrite was lost slowly and emphasised that the error was serious when nitrite was being removed from the system (as in nitrite reductase assay) but not when it was being formed (as in nitrate reductase assay). It would be expected, however, that the estimation of nitrite would be subject to the same errors when it is being removed as an end-product as when it is present as a substrate. In fact, Table I shows that in nitrate reductase systems the loss of nitrite due to the presence of reduced diphosphopyridine nucleotide (DPNH) may be as high as 70%. In studies of the adaptive formation of the enzyme<sup>2,7,8</sup> this error may become very serious. In standard nitrite solutions the relationship between nitrite present and the extinction curve of the coloured end-product after diazotisation approximated to Beer's Law up to 200  $\mu$  M of nitrite in 10 ml. in the presence of any given concentration of DPNH<sup>5</sup>

but the values observed for nitrite decrease in a non-linear manner. Lastly it may be pointed out that the loss of nitrite in standard solutions may be up to 80% depending upon the quantity of DPNH present (Table I), and that, contrary to the observation of Medina and Nicholas<sup>6</sup> it takes place very rapidly.

TABLE I

DPNH Interference with NO<sub>2</sub> Estimation and its Prevention

Standard Nitrate Solution  
(Values as % of NO<sub>2</sub> added)

Experiment No.	Untreated				All three concentrations of DPNH treated with	
	Amount of DPNH present (mg.)				Zn or Ba acetate and ethyl alcohol	ADH and acetaldehyde
	0	0.1	0.2	0.4		
1	100	60.2	40.1	20.05	100	100
2	100	69.0	41.0	20.00	100	100

Nitrate Reductase Assay System  
Total enzyme activity in canliflower leaves using 0.4 mg. DPNH

Experiment No.	Untreated	Residual DPNH removed by Zn or Ba acetate and ethyl alcohol	Residual DPNH removed by ADH and acetaldehyde
1	40.0	74.3	74.0
2	82.5	100.0	100.5
3	83.2	103.8	104.0

Note.—Sodium dodecyl sulphate was used in nitrate reductase assays.

Although reduced triphosphopyridine nucleotide (TPNH) may cause somewhat less interference than DPNH, its far greater cost and the existence of some DPNH-specific enzyme

systems requires the use of DPNH on many occasions. Medina and Nicholas<sup>6</sup> proposed the use of a barium-alcohol precipitation method for the removal of residual reduced pyridine nucleotides. In the present investigation, using either barium or zinc acetate, this method was found to be effective only for small aliquots of reaction mixture. When much phosphate was present, or when the volume of the reaction mixture exceeded 1 ml., the large increase in volume produced by the addition of alcohol substantially reduced the sensitivity of the method. Moreover, precipitation and centrifugation made the assay unnecessarily time-consuming. Several other methods for the rapid destruction of residual DPNH, including lowering pH of the assay mixture and the use of ferricyanide at the end of the reaction period, proved unsuitable.

However, as the oxidised form, DPN, does not interfere with nitrite estimation, a method was evolved for the rapid oxidation of the residual DPNH by enzymic means using alcohol dehydrogenase (ADH). This simple method has been used in routine work for the last few years,<sup>9</sup> and is described below:

To an enzyme assay reaction mixture (pH 7.5 or below) in a volume of 4.5 ml. or less containing up to 0.4 mg. DPNH, is added at the end of the reaction period enough M acetaldehyde solution to make the latter's final concentration 0.1 M. This is rapidly followed by the addition of 0.1 ml. ADH solution containing  $2.5 \times 10^3$  Racker units per ml. (1 unit =  $\Delta \log I/I_0$  0.001 per min. from 15 sec. to 45 sec.). This treatment results in complete recovery of nitrite (Table I) as the oxidation of DPNH is almost complete within 15 seconds and the enzyme assay is virtually terminated at the same time. Since a fair preparation of ADH<sup>10</sup> should yield about  $5 \times 10^{10}$  units of ADH in stable form, this provides sufficient enzyme for 2,000 incubation tubes, i.e., for several hundred actual assays.

The second major error, caused by the precipitation of protein on adding the acid sulphanilamide reagent is also significant. Attempts to remove the precipitated protein by centrifuging, either before or after the formation of the coloured end-product, resulted in considerable, albeit variable losses of nitrite. This happens presumably because nitrite in the first case, and the red azo-dye in the second, gets adsorbed on the surface of the precipitated proteins; both can be partially recovered by resuspending the centrifuged proteins. Colourimetric readings taken without centrifugation would become equally unreliable should the light

absorbance of the adsorbed dye be different from that of the dye in solution. Attempts were, therefore, made to find a suitable protein denaturant that could be used to prevent its precipitation without interfering with the nitrite estimation. The substances tested and found unsuitable included ammonium sulphate, urea, sodium tungstate, hydrochloric acid, metaphosphoric acid, osmic acid, formic acid, acetic acid, trichloroacetic acid, acetone, methyl alcohol, ethyl alcohol, normal and iso-butyl alcohols and normal and isoamyl alcohols. Centrifugation and resuspension of the pellet after the addition of these reagents also proved unsuccessful in recovering the nitrite completely. Several aliphatic detergents, including 'Teepol', cetyl pyridinium chloride, polyethylene glycol 600 mono-oleate, 'Texofar F 15', 'Manoxol N', sodium tetradecyl sulphate and sodium dodecyl (lauryl) sulphate, were also tested. Of these the last detergent proved suitable when 0.5–1 ml. of a 9 mg./ml. solution was added to the reaction mixture preferably before adding the acid sulphanilamide reagent. This maintains up to 5 mg. of plant protein in a clear disperse state without interfering with the nitrite estimation.

The combined use of alcohol dehydrogenase and sodium dodecyl sulphate is, therefore, recommended for rapid, reproducible and accurate estimations of nitrite in the presence of DPNH and protein components of the assay system.

This investigation was carried out at the University of Bristol Agricultural and Horticultural Research Station, Long Ashton (England), during the tenure of a Colombo Plan Fellowship and Study Leave from the Aligarh Muslim University, Aligarh. The author is indebted to the Director of the Research Station for the facilities provided and to Dr. E. J. Hewitt for personal interest in the problem. Thanks are also due to Dr. E. Somers for the supply of samples of detergents.

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## CLASTIC DEPOSITION OF SIWALIK SEDIMENTS (C.M. PATTERNS\*)

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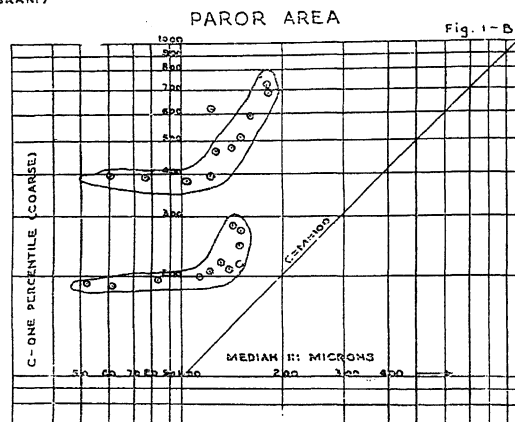
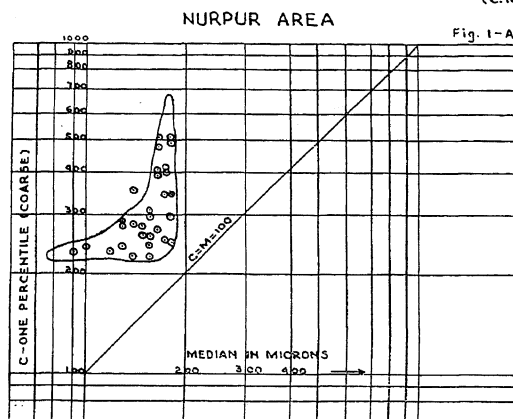
THE texture of clastic sediments as characteristic of environment of deposition has been noted by many workers. Passega (1957) has correlated the texture of clastic sediments as reflected by sample point pattern (C.M. Pattern) with the depositional agent. These patterns are obtained by plotting C—the coarsest one percentile against M—the median. Plots for Siwalik sediments have been obtained by analysing nearly 200 representative samples and are shown in Figs. 1-3. The samples analysed were collected from exposed Siwaliks of Nurpur (Mansar anticline), Dharmasala (Paror anticline) and Janauri areas in the Punjab. The patterns obtained are fairly comparable to those of

more than 200 microns. The coarse end of C is peaked. The sands show selective sorting; and probably represent deposition under migrating deltaic to open channel conditions. Sandstones from Paror area on the other hand give the patterns as shown in Fig. 1 (B). The patterns resemble the finer end of shelf sediments and may represent deposits on tidal flats. The textural patterns of Lower Siwalik sandstones seem to suggest fluvio-deltaic and shallow basinal type of deposition.

The Middle Siwalik sandstones from Nurpur show an incomplete river pattern (Fig. 2) with erratic disposition of sample points in the coarse end. Similar pattern is also noted in

## LOWER SIWALIKS

(C.M. DIAGRAM)



Passega for some modern sediments and are suggestive of their depositional conditions.

Lower Siwalik sandstones from Nurpur area gave a pattern as shown in Fig. 1 (A). They are medium to fine grained moderately sorted sands with the median varying between 90 and 200 microns and the coarsest one percentile varying between 220 and 550 microns. The sorting coefficient of the sands varies between 1.6 and 3.5. The crescent-shaped pattern obtained for these sands resembles an incomplete river pattern, but is different from a true river pattern in the absence of material with median value of

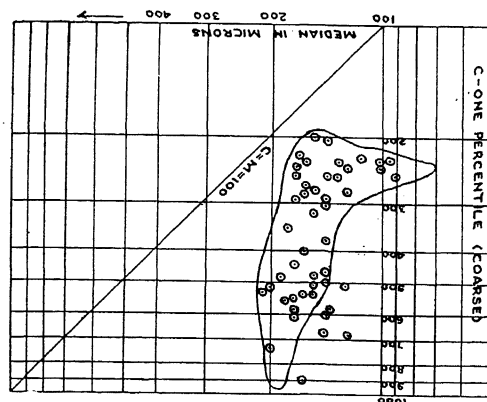


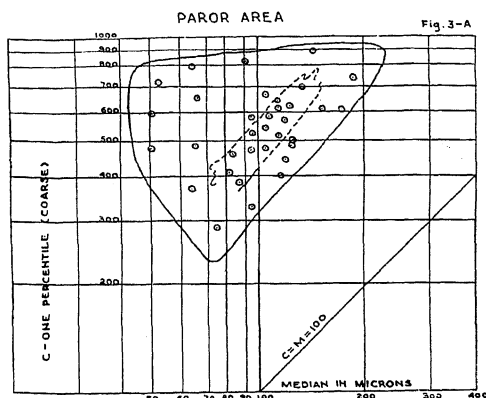
FIG. 2

\* Published with kind permission of Director of Geology, Oil and Natural Gas Commission, Dehra Dun. The views expressed in the note are those of the authors only and not necessarily of the O.N.G. Commission.

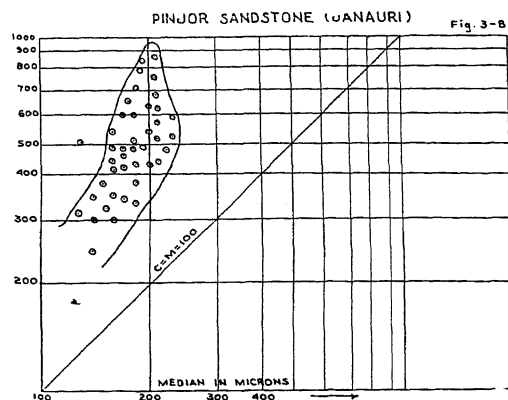
the Upper Siwalik sandstones (Pinjor-sandstones) from Janauri area [Fig. 3 (B)]. These patterns represent river-bed deposits similar to the Nibrar river sands (studied by Passega)

the basal part of Upper Siwaliks with a stable subrounded tourmaline assemblage show a linear CM relationship and probably represent re-worked sediments.

UPPER SIWALIKS  
(C. M. DIAGRAM)



and confirm the fluviatile origin of Middle and Upper Siwalik sediments. However, pattern in Fig. 3 (A) which represents Upper Siwalik pebbly sands in Paror area shows a completely erratic sample point distribution. This may be attributed to the fact that in this part of the Punjab the Upper Siwaliks are formed as "inter-Siwalik valley-infillings" under completely continental conditions.<sup>3</sup> A few samples from



Siwalik sediments, therefore, are the products of deposition under varying conditions, even though the fluviatile nature of Middle and Upper Siwaliks is suggested by this study.

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## APPLICATION OF CHEMICAL ANALYSIS TO SOME CASES OF SYNONYMY IN BOTANICAL NOMENCLATURE

S. RANGASWAMI

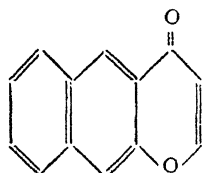
Andhra University, Waltair

ON account of inherent difficulties, detailed chemical study of plants as an aid to plant classification has not made much headway. It may be said in general that where such study has been made it has corroborated the findings of the systematic botanists as far as individuality of botanical species is concerned. But instances have recently come to light where the chemical study has rightly indicated the need for a revision of the opinion of botanists. A few fresh instances of this nature are mentioned below:

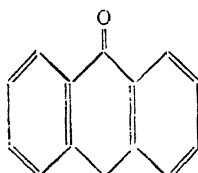
Although Linnaeus recognised the two species of *Cassia* (N.O. Leguminosæ) named as *Cassia tora* Linn. and *Cassia obtusifolia* Linn. as distinct, there has recently been a tendency to consider the two names as synonymous.

Chemical information is now available regarding the seeds of both the species. *Cassia tora* seed has been found to contain, among others, rubrofusarin and norrubrofusarin<sup>1</sup> which are derivatives of naphtho- $\gamma$ -pyrone<sup>2</sup> (I) (previously considered erroneously to be xanthone derivatives).<sup>3</sup> On the other hand *Cassia obtusifolia* seed has been found to contain a number of anthraquinone (II) compounds, viz., chryso-phenol, physcion, obtusifolin, obtusin, chryso-obtusin and aurantio-obtusin.<sup>4</sup> The difference between two groups of chemical compounds is unmistakable and there seems to be ample justification for considering the two species as distinct, as indeed Linnaeus originally did. In a paper entitled "A revision of the genus *Cassia* (Cæsalp.) as occurring in Malaysia" published

in *Webbia*, 1955, 11, 197-292, De Witt (H.C.D.) accepts *Cassia tora* Linn. as distinct from *Cassia obtusifolia* Linn.,\* thus agreeing with the chemical finding.



I

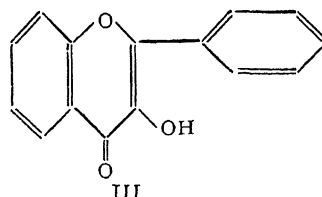


II

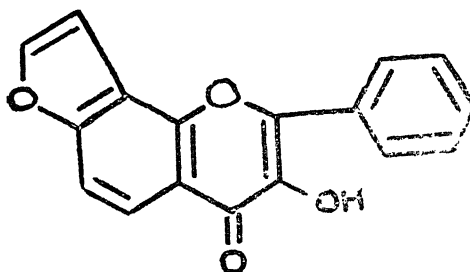
Another case is that of the two species *Pongamia glabra* Vent. and *Pongamia pinnata* (Linn.) Merr. (N.O. Leguminosæ). The former is found widely distributed in South India and the latter in Australia. Botanists have considered them as synonymous but their chemical features indicate unmistakable divergence. Detailed studies of the chemical components of different parts of *Pongamia glabra*, the seeds, flowers, stem-bark and root-bark have been made; but in the case of *Pongamia pinnata* only the root-bark has been studied chemically. Hence in order to be valid the comparison has to be restricted to the composition of the root-bark of the two species. The root-bark of *P. glabra* has been found to contain two closely related flavonol (III) methyl ethers namely kanugin and desmethoxykanugin.<sup>5-7</sup> On the other hand *Pongamia pinnata* root-bark contains four furanoflavones.<sup>8,9</sup> Two of these karanjin and pongapin are angular furanoflavonol (IV a) derivatives and the other two, gamatin and pinnatin are linear furanoflavones (IV b). The difference in the chemical composition between the two roots seems to be quite definite. On this score the two names *Pongamia glabra* and *Pongamia pinnata* seem to refer to different species and they need not be taken to be synonymous.

There seems to be a third case also which is interesting. *Daucus carota* Linn. var. *sativa* DC. (N.O. Umbelliferae), the cultivated carrot of European origin, is now grown widely in different parts of the world. The root tubers invariably contain carotene ( $\beta$ ) and carotenoids and the material-pigment relationship is aptly brought out by the names; they are made up of isoprene units (V). There is a carrot indigenous to India commonly used in making sweet preparations. It is intensely red or black in appearance and contains a deep red pigment most intense in the outer layers. It is remarkable in being rich in cyanidin diglucoside (C<sub>13</sub> skeleton, VI) and in being completely devoid

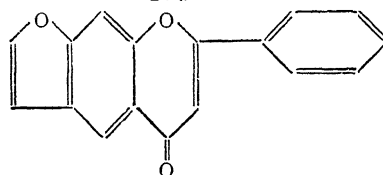
of carotene and carotenoid pigments.<sup>10</sup> The difference in the pigment components is very marked and the habitat also seems to be



III

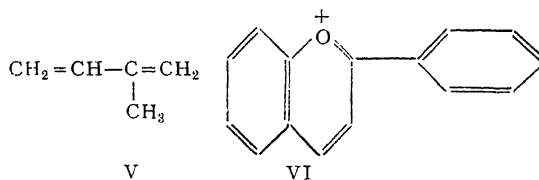


IV a

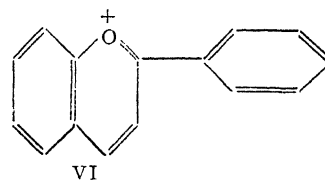


IV b

definitely demarked. It would appear that here again we are dealing with two distinct species and not the same species.



V



VI

\* The author thanks Dr. H. Santapau, Chief Botanist Botanical Survey of India for this information.

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## LETTERS TO THE EDITOR

### DECOMPOSITION OF A CLASS OF STATIONARY PROCESSES

A WIDE-SENSE stationary discrete real process  $X(n)$  whose covariance sequence

$$R(k) = \begin{cases} a^2 & \text{for } k = 0 \\ \text{and} \\ b^2 & \text{for } k = \pm 1, \pm 2, \dots, \pm p, \end{cases}$$

where  $a$  and  $b$  are real constants, and  $a^2 > b^2$ , is sometimes referred to as an Equally-Correlated process.<sup>1</sup> The positive integer  $p$  is known as the correlation length.

If the correlation length is infinite, the process  $X(n)$  is shown by S. M. Berman<sup>2</sup> by consideration of an ergodic theorem to have a representation of the form:

$$X(n) = U(n) + V,$$

where  $U(n)$  is a non-autocorrelated stationary process, and  $V$  is a random variable uncorrelated with any  $U(n)$ .

The authors obtain this relationship directly by the use of spectral representation of H. Cramér.<sup>3</sup> The spectrum of  $X(n)$  is seen to be the sum of two parts, one of which is absolutely continuous [with constant density  $(1/2\pi)(a^2 - b^2)$ ], which corresponds to a non-autocorrelated stationary process  $U(n)$ , and the other a pure step part with a single saltus of  $b^2$  at the origin, which corresponds to a stationary process of perfectly correlated variates:  $V(n) = V$ , say. The following are some main points which may be noted:

1. The method is an instance of the effectiveness of spectral representation as a tool for analysis.
2. The nature of the two parts of the spectrum shows that  $V$  is uncorrelated to any  $U(n)$ .
3. Hilbert space of  $U(n)$  is purely non-deterministic in the sense of Karhunen, while that of  $V$  is purely deterministic.
4. The result that  $X(n) = U(n) + V$  is what H. Wold's Decomposition<sup>4</sup> reduces to in this case.
5. Though the process  $X(n)$  can be regarded as one with covariance sequence which is the limit of making the correlation length increase unboundedly, the spectrum of  $X(n)$  may not be derivable by a limit process, starting with the spectrum of the process with a finite  $p$ .

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### X-RAY DETERMINATION OF THE THERMAL EXPANSION OF TUNGSTEN

In a recent paper Parrish<sup>1</sup> has referred to a private communication by Dame Lonsdale in which she has pointed out that there are no reports on the X-ray measurements of the thermal expansion of tungsten. This laboratory had obtained a standard sample of tungsten powder from the Chairman of the Commission on Crystallographic Apparatus in connection with the I.U.Cr. project on precision determination of lattice parameters. It was considered that a detailed and accurate study of the temperature variation of cell constant and the coefficient of thermal expansion of this metal will be of interest. This paper presents the results of such a study over the range of temperature from 24° C. to 526° C.

The powder diffraction work was done with a Unicam 19 cm. high-temperature camera and copper K radiation. The heating current was obtained from a stabilized voltage transformer and the specimen temperatures were maintained constant, reproducibly, within 1° C. Actual values of the specimen temperatures were determined by using spectroscopically pure aluminium powder as a standard substance. Aluminium powder was either mixed with tungsten to get composite pictures or separate pictures of the two powders were obtained exactly at the same temperature. Both the powders were annealed before use. Wilson's<sup>2</sup> data on the temperature variation of the lattice constant of aluminium were used to evaluate the temperatures.

The work was done in more than two sets, taking care to reproduce the same temperatures within the accuracy mentioned above. Each film was measured repeatedly and the lattice parameter was evaluated accurately by Cohen's<sup>3</sup> method, using Nelson and Riley's<sup>4</sup> extrapolation

function. The final value of the cell constant at any temperature given below is the mean of the results of two or more films. The maximum deviation of the results of the individual films at any temperature from the corresponding mean was  $\pm 0.00018 \text{ \AA}$  and this has been taken as the limit of accuracy for all the values. Results from one film at each temperature were processed by Jette and Foote's<sup>5</sup> method to get the value of the standard deviations. It was found that the maximum standard deviation obtained was of the same order as the error given above. Finally, the error due to refraction was corrected by adding to the lattice parameter at each temperature a correction<sup>1</sup> equal to  $0.00016 \text{ \AA}$ . It was found that this correction remains almost the same over the whole range of temperature.

The temperature variation of the lattice parameter is shown in Fig. 1. This variation

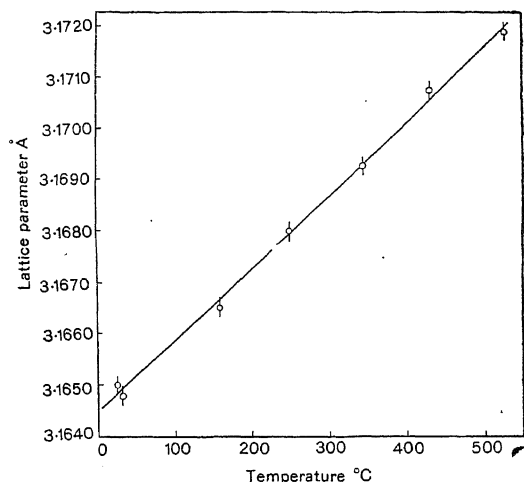


FIG. 1

appears to be non-linear although the departure from linearity is very small. To test this and to get accurate values of the lattice parameter at different temperatures, the temperature-parameter data were subjected to a least squares treatment. The equation thus obtained was

$$a_t = 3.16475 + 13.70 \times 10^{-6}(t-20) + 10.98 \times 10^{-10}(t-20)^2.$$

Differentiation of this expression with respect to temperature gives the following relation for the dependence on temperature of the coefficient of thermal expansion, defined by  $\alpha_t = 1/a_{20} (da_t/dt)$ ,

$$\alpha_t = 4.33 \times 10^{-6} + 6.94 \times 10^{-6}(t-20).$$

Table I gives the values of the lattice parameter and the coefficient of thermal expansion, at some temperatures in the range covered, as obtained from these relations.

TABLE I

Lattice constant and the coefficient of thermal expansion of tungsten at different temperatures

Temperature °C.	$a_t$ Å	$\alpha_t \times 10^6$
20	3.16475	4.33
100	3.16586	4.38
200	3.16726	4.45
300	3.16868	4.52
400	3.17002	4.59
500	3.17158	4.66

The value of the lattice constant at  $25^\circ \text{C}$ . obtained in the present work is compared with the values available in literature in Table II.

TABLE II

Values of the lattice constant of tungsten at  $25^\circ \text{C}$ .

$a_{25}$ Å	Authors
$3.16482 \pm 0.00018$	Present work
$3.16475 \pm 0.00012$	Jette and Foote <sup>5</sup>
$3.1651 \pm 0.0002$	Straumanis and Ievins <sup>8</sup>
$3.1648$	Swanson and Tatge <sup>9</sup>
$3.16520 \pm 0.00012^*$	Parrish <sup>1</sup>
$3.165072 \pm 0.000037$	Vogel and Kempter <sup>10</sup>
$3.16515 \pm 0.00009^\dagger$	Deshpande, Khan and Ramrao <sup>11</sup>

\* Arithmetic mean of fifteen independent determinations.

† Arithmetic mean of two independent determinations.

The agreement is considered to be quite satisfactory. The mean value of the coefficient of expansion over the range  $20^\circ$ – $500^\circ \text{C}$ . is  $4.50 \times 10^{-6}$ . This agrees well with the value  $4.56 \times 10^{-6}$  given by Dodge<sup>6</sup> for the range  $20^\circ$ – $678^\circ \text{C}$ . and  $4.50 \times 10^{-6}$  reported by Goucher<sup>7</sup> for the range  $0^\circ$ – $577^\circ \text{C}$ .

The authors wish to express their thanks to Dr. Parrish for supplying the specimen powder and to C.S.I.R. for the grant of a Research Fellowship to one of them (R. P.).

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## SEMIDIURNAL VARIATION OF COSMIC RAY NUCLEONIC INTENSITY

A PRELIMINARY report of a study of the semidiurnal variation of Cosmic ray nucleonic intensity is presented. The data of Huancayo ( $\lambda = 0^\circ 6'$ , Ht. 3,400 meters) and Climax ( $\lambda = 48^\circ$ , Ht. 3,400 meters) for the period July 1957 to March 1958 are used.

The monthly mean semidiurnal amplitude and phase are calculated by harmonic analysis. Only those days in a month for which all the 12 bihourly values are available are used. To study the relation between semidiurnal variation and geomagnetic and solar activities the monthly mean amplitudes, monthly sum of geomagnetic planetary index  $K_p$  and monthly mean sunspot numbers are plotted in Fig. 1.

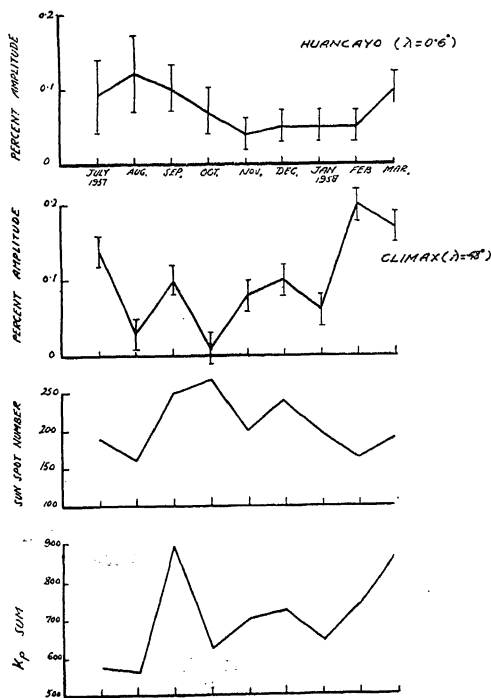


FIG. 1. Diagram showing the monthly mean semidiurnal amplitude for Huancayo and Climax for the period July 1957-March 1958. Monthly mean relative sunspot numbers and  $K_p$  sum are also given.

The monthly means of times of maximum,  $K_p$  sums, and relative sunspot numbers are shown in Fig. 3. In Fig. 2, the monthly mean amplitudes and the per cent. deviation from the mean of all months of the monthly mean intensity are plotted.

It can be seen from Figs. 1 and 2 that the

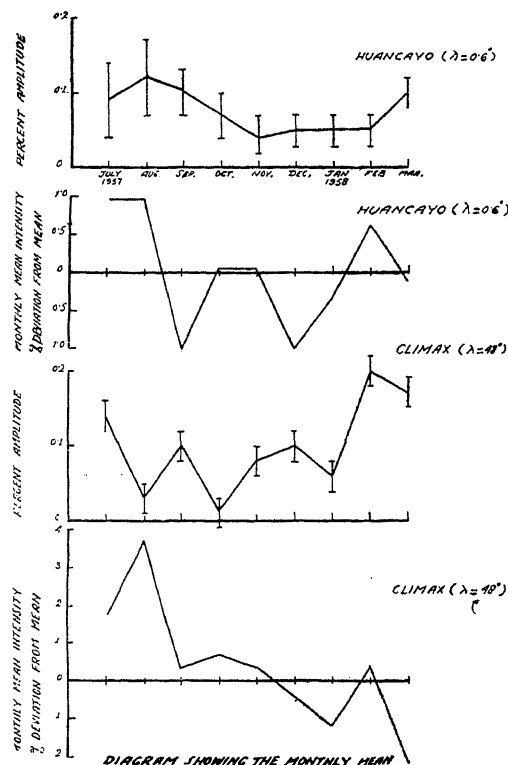


FIG. 2. Diagram showing the monthly mean semidiurnal amplitude and intensity for Huancayo and Climax for the period July 1957-March 1958.

semidiurnal amplitude and phase are variable in character. The changes in amplitude are more pronounced at Climax than at Huancayo. Unlike the diurnal variation, the variations in amplitude are not in the same sense at the two stations. The amplitude at Huancayo does not show any dependence on  $K_p$ . However, there is better correlation between the amplitude at Climax and  $K_p$ . Sastry and Gill<sup>1</sup> have shown that the diurnal amplitude increases on days of low mean intensity. But the semidiurnal amplitude as can be seen from Fig. 2 does not show any such relation at either latitudes.

The times of maximum at the two stations are better correlated. Figure 3 shows that the times of maximum do not show any apparent

dependence on  $K_p$ , or sunspot number or daily mean intensity.

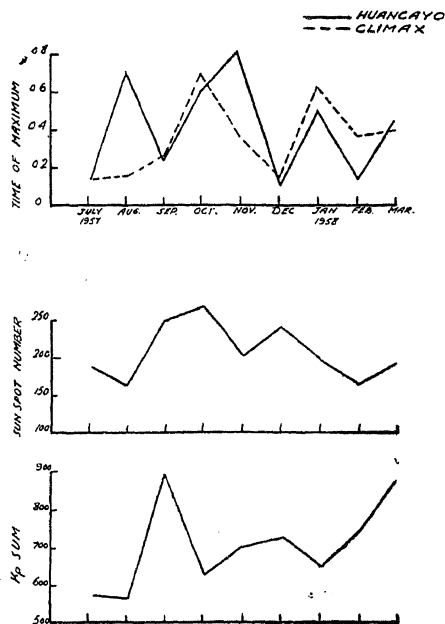


FIG. 3. Diagram showing the monthly mean phase of the semi-diurnal variation from July 1957–March 1958 at Climax and Huancaayo.

Semidiurnal variation of Meson intensity has been studied previously. Sekido and Yoshida<sup>2</sup> find that the amplitude gets reduced on high  $K_p$  days. Venkatesan and Dattner<sup>3</sup> find that the time of maximum of semidiurnal variation are significantly different at different latitudes and the changes in the time of maximum are not correlated at different stations. But for nucleonic intensity there seems to be positive correlation between amplitudes and  $K_p$  at high latitudes. The average amplitude and time of maximum for Huancaayo are  $0.08 \pm 0.01\%$  and 04 hrs. 4 min. and that for Climax are  $0.10 \pm 0.005\%$  and 03 hrs. 36 min. From the average amplitude and phase it appears that there is no latitude dependence for both of them. A detailed study of the semidiurnal variation is being made using the IGY worldwide data and the results will be published elsewhere.

The author wishes to thank Prof. P. S. Gill under whose guidance this work was done. His thanks are also due to Prof. J. A. Simpson, of the University of Chicago, for supplying the data.

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### EFFECT OF ULTRASONICS ON THE ESTERIFICATION OF ETHYL ALCOHOL

CHEMICAL effects<sup>1</sup> of ultrasonics have been extensively reported in literature. Most of these reactions have been studied in presence of a catalyst with the result that the contribution due to ultrasonics was not clearly estimated. In the present work the effect of ultrasonics on the esterification reaction has been studied qualitatively but without the use of any catalyst and with removal of the accompanying heat effect.

The liquid container used was a double-walled vessel through which water was circulated to remove the heat produced by ultrasonics. It had a thin mica sheet fixed leakproof to the bottom which transmitted the ultrasonic beam to the mixture without much loss of intensity. The crystal and the liquid container were vertically aligned. The crystal was excited with a 50 watts r.f. generator at a frequency of one megacycle. The infra-red spectrum was taken by a double beam infra-red spectrometer (Hilger) with the liquid containing cell of 0.1 mm. thickness. The spectra of pure ethyl acetate, acetic acid and acetic anhydride were taken individually. The reactive mixture was divided into two equal parts. One part was treated with ultrasonics for a given length of time and the other was kept for the same length of time at the room temperature. These samples were then compared by means of infrared. In the first case where the heat due to ultrasonic irradiation was not removed, the comparison was done in the spectra of the untreated sample, the ultrasonically treated part, as also a third untreated sample which was externally heated to the temperature produced by ultrasonics. The results are shown in Figs. 1-3, each of which includes several curves displaced vertically for the purpose of comparison. The horizontal lines in each figure represent a transmission difference of 10% and the transmittance at  $5\mu$  is indicated at the start of the curve.

The infra-red spectrum of individual substances showed that the ethyl acetate band could

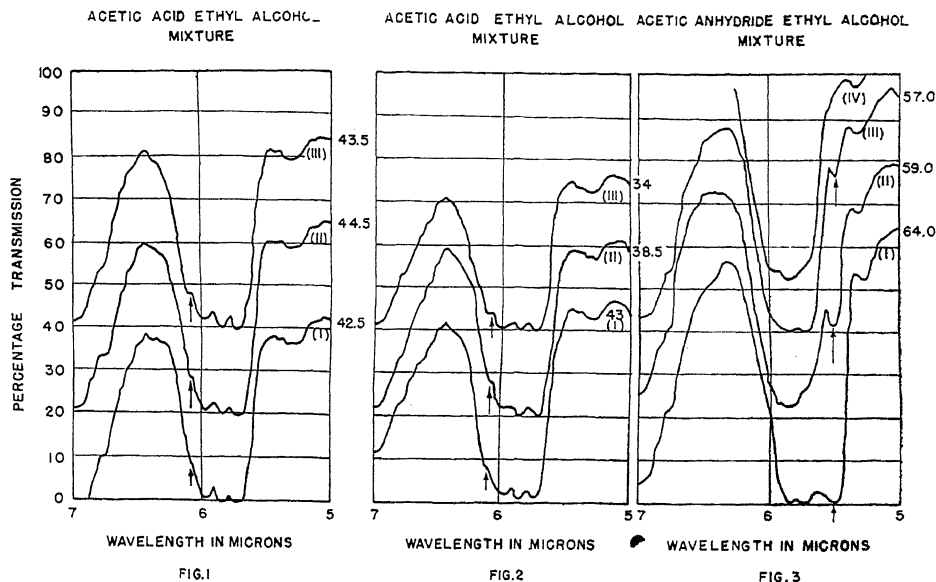
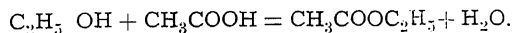


FIG. 1. Infra-red spectra between 5 and 7  $\mu$  of a 1:1 mixture of ethyl alcohol and acetic acid; curve (i) immediately after mixing [other curves taken at different intervals after mixing are not included here for the sake of clarity as they are similar to curve (i)], curve (ii) after 6 hours of ultrasonic irradiation and curve (iii) after 9 hours of ultrasonic irradiation. The temperature was maintained constant during irradiation. FIG. 2. Infra-red spectra between 5 and 7  $\mu$  of 1:1 mixture of ethyl alcohol and acetic acid; curve (i) immediately after mixing, curve (ii) after heating the mixture externally for 30 minutes and curve (iii) after irradiating the mixture with ultrasonics for 30 minutes. FIG. 3. Infra-red spectra between 5 and 7  $\mu$  of a mixture of ethyl alcohol and acetic anhydride; curve (i) immediately after mixing, curve (ii), curve (iii) and curve (iv) at 17, 40 and 60 hours after mixing respectively.

not be utilised for the purpose of comparison because it lies in the region 5 to 6  $\mu$  where several bands of acetic acid and also of acetic anhydride exist. The available alternative was to study the band of free water which is also a product of the reaction. An absorption band of medium intensity near 6.15  $\mu$  was chosen for this purpose. The other bands of free water lying in the region 2 to 3  $\mu$  were not fully amenable for observations as this region also contains very broad bands of acetic acid and ethyl alcohol.

(a) *Ethyl alcohol and acetic acid mixture*

The reactants were taken in equimolecular proportions, the reaction being represented by the equation

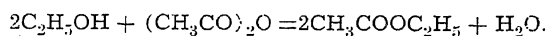


It was found that the band at 6.15  $\mu$  grows in the mixture through which ultrasonics has been passed while it is very weak in other cases. This is shown in Fig. 1 which represents the observations on the various samples in which temperature was kept constant. It shows that ultrasonic irradiation influences the progress of the reaction, the production of greater amount of free water indicating that the rate of esterification is accelerated

by ultrasonics. The same result also follows from Fig. 2, where the effect of irradiation by ultrasonics is much more marked than the effect of heating for the corresponding period to the same temperature. These results have been confirmed by a number of observations taken over a period of several days.

(b) *Ethyl alcohol and acetic anhydride mixture*

Another reaction chosen for the study was ethyl alcohol acetic anhydride mixture which proceeds very fast. The reactants were taken in molecular proportion represented by the equation



The infra-red study of the mixture showed that the C=O band at about 5.4  $\mu$  starts diminishing in intensity as time proceeds. This band represents the anhydride band because it does not appear in the spectrum of ethyl acetate (Barnes *et al.*, 1944).<sup>2</sup> It diminishes appreciably in about 14 hours time and completely vanishes in about 36 hours. Ultrasonic irradiation for 12 hours did not reveal any change in the pattern of this band. Thus it appeared that the rate of this reaction is not affected by ultrasonics. It seems likely that this is due

to the masking of the ultrasonic effect by the time effect.

National Phys. Lab.,  
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### ANGULAR WIDTH OF HIGH FREQUENCY DIFFRACTION IN ACETONE

High frequency sound waves up to 150 Mc./s. are propagated into acetone, the sound absorption coefficient<sup>1</sup> of which is slightly greater than that of water. Adopting the same procedure as reported in an earlier publication,<sup>2</sup> the angular distribution of intensity of the first-order diffraction is studied with the help of a photo-tube. 'Analar' acetone is used throughout the study.

The angle of tilt ' $\theta$ ' of the crystal holder, corresponding to the maximum intensity of the diffraction order as observed by the photo-tube and that calculated from the Bragg relation  $\lambda/\lambda^* = 2\mu_0 \sin \theta$  are given in Table I for several sound frequencies.

TABLE I

Frequency in Mc./s.	' $\theta$ ' in minutes of arc	
	By photo-tube	By calculation
23.06	15.0'	14.0'
49.97	30.5'	31.0'
73.04	47.0'	46.0'
91.20	59.0'	58.5'
149.80	95.0'	94.0'

TABLE II

Temperature = 28° C. Length of the sound field = 1.5 cm.

Frequency in Mc./s.	$\phi$ in minutes of arc	
	By Photo-tube	By calculation
23.06	12.5'	12.0'
49.97	6.0'	5.9'
73.04	4.0'	4.0'
91.20	3.2'	3.1'
149.80	2.0'	1.9'

Table I shows satisfactory agreement between observed and calculated values.

To observe the angular width of high frequency diffraction, the intensity maxima of the first orders of diffraction, for all the five frequencies employed, are adjusted to be the same and the effect of tilt studied by the photo-tube. The angle  $\phi$  corresponding to the position of disappearance of the diffraction order, as observed by the photo-tube and calculated from David's intensity expression,<sup>3</sup> are shown in Table II.

Figure 1 shows a plot of the observed and calculated values of  $\phi$  against sound frequency. It clearly indicates the dependence of the angular width of high frequency diffraction on sound wavelength.

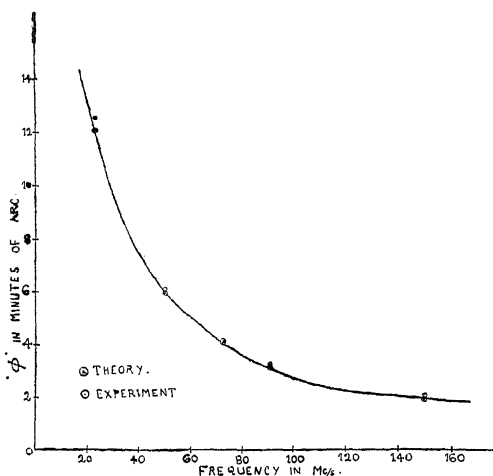


FIG. 1. Dependence of ' $\phi$ ' on sound frequency in acetone.

Two significant results obtained from this study are that:—

(a) the intensity of the first-order diffraction always attains its maximum at its appropriate Bragg angle, supporting strongly the idea of characteristic reflection put forward by Brillouin<sup>4</sup>;

(b) that the angular width of high frequency diffraction depends only upon the sound wavelength in the medium and on no other factor like the intensity of the sound beam or the wavelength of the incident light. It decreases with increase of frequency.

In conclusion, I wish to thank Prof. S. Bhagavantam for his kind interest in this work.

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# SPECTROPHOTOMETRIC STUDY ON THE BIURET REACTION OF CYANURIC ACID

In the present communication the composition and the stability constant of the copper-cyanuric acid complex have been determined. All the reagents used were either A.R. sample or purified by crystallisation. A solution of cyanuric acid was prepared by dissolving a known amount in double distilled water having equivalent amount of KOH. Absorption experiments were carried out with a Bausch and Lomb 'Spectronic 20'.

First, the method of Vosburgh and Cooper<sup>2</sup> was employed to see the number of complexes formed. Only one maximum (at  $675 \mu$ ) was obtained showing the formation of one complex only.

Job's method of continued variation<sup>3</sup> was employed to find the composition of the complex. Solutions of copper sulphate ( $5.0 \times 10^{-3} \text{ M}$ ) and cyanuric acid ( $5.0 \times 10^{-3} \text{ M}$ ) were mixed according to the method of continued variation, and 10 c.c. of 1.7 M KOH was added, making the total volume to 20 c.c. The absorption of these solutions was measured at  $675 \mu$ . In order to account for the absorption values of copper, the absorption of solutions made under identical condition, but in absence of cyanuric acid, was determined at  $675 \mu$ . A graph was plotted between the amount of copper and difference in optical density of complex and the metal ion alone (Fig. 1). Cyanuric acid being

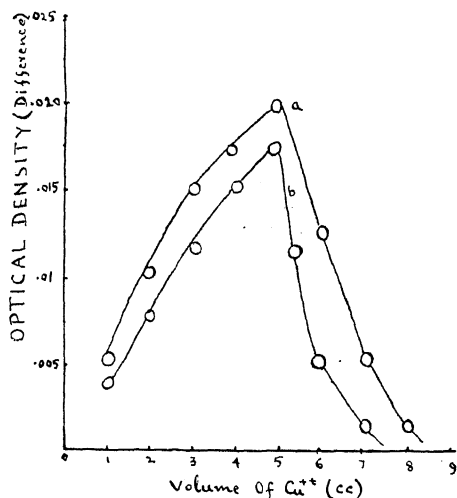
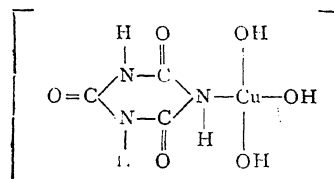


FIG. 1 (a) for  $5.0 \times 10^{-3} \text{ M}$  of the Reactants; (b) for  $4.4 \times 10^{-3} \text{ M}$  of the Reactants. colourless does not contribute towards the absorption value of the complex. The experi-

ment was repeated for  $4.44 \times 10^{-3} \text{ M}$  of the reactants. A peak (Fig. 1) was obtained at a concentration corresponding to a molar ratio 1:1 of the reactants.

The results of continued variation were checked by Molar ratio method.<sup>4</sup> It is interesting to note that a molar ratio of 1:1 was also found from this method. Hence the composition of the complex may be written as



which confirms the result of polarography.<sup>1</sup>

The stability constant of the complex was determined by the equation  $K = x/(a-x)(b-x)$  where  $a, b$  are the concentration of the reactants and  $x$  is the concentration of the complex.  $x$  was calculated from the equation  $x = a_2 b_2 - a_1 b_1 / (a_2 + b_2) - (a_1 + b_1)$  where  $a_1, b_1$  and  $a_2, b_2$  are the two concentrations of the reactants having the same optical density. The value of  $K$  was found to be  $7.7 \times 10^2$ . From this the value of the free energy of formation was calculated by the equation  $-\Delta F = RT \ln K$ . The free energy comes out to be  $-3.957 \text{ K.Cal.}$  at  $25^\circ \text{ C}$ .

Thanks are due to Prof. Akhlaq R. Kidwai for his interest in the work.

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## INVESTIGATIONS ON THE VENOM OF THE INDIAN SCORPION, HETEROMETRUS SCABER

VERY little work seems to have been done so far on the venom of the Indian scorpion, *Heterometrus scaber* (family—Scorpioninae). The venoms of some Brazilian and North-African species have been investigated to certain extent<sup>1-5</sup> but *Heterometrus scaber* belongs to quite a different species.

The protein make-up and free amino-acid composition of the venom were investigated.

The venom was collected manually and was a milky fluid. The paper electrophoresis was run, using 0.05 M. barbitone buffer, pH 8.6. A voltage of 150 was applied and the time of run was 16 hours. The paper after drying was stained with bromophenol blue, and scanned in a densitometer. The results are given in Fig. 1.

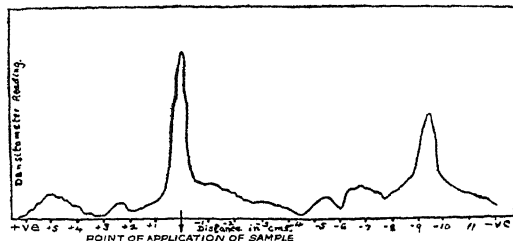


FIG. 1. Paper electrophoresis of scorpion venom.

The venom can be separated into 6 protein components, 3 cathodic, 2 anodic and one remaining more or less at the point of application of the sample. Electrophoresis of the hæmolymph of the animal under similar conditions gave 4 components all anodic, one albumin-like main component and three other fractions (Fig. 2).

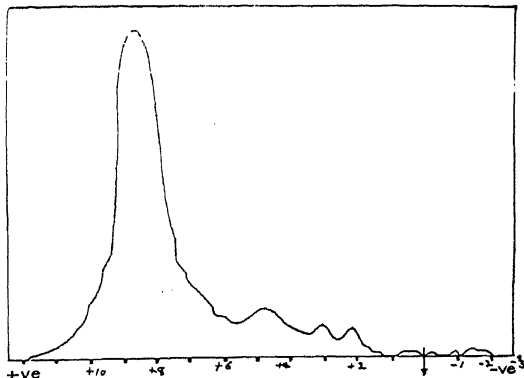


FIG. 2. Paper electrophoresis of scorpion hæmolymph.

Electrophoretic pattern of the hæmolymph more or less resembles that of human serum, but in the venom, in addition to two fractions which migrate towards the anode, there are three other fractions which migrate to the cathode. These cathodic fractions may quite possibly have some significance in relation to the toxicity of the venom. Further work in this direction is in progress.

The free amino-acid pattern of the venom was studied by deproteinising the venom with 85% alcohol. The deproteinised alcoholic solution was extracted with chloroform (three volumes for one volume of alcoholic solution), and the

aqueous layer after concentration in vacuum was used. Circular paper chromatography using *n*-butanol : acetic acid : water (40 : 10 : 50) was carried out. 0.1% Ninhydrin in acetone was used as the reagent for locating amino-acids. The following amino-acids were detected : alanine, glutamic acid, glycine aspartic acid, leucine, tryptophan, tyrosine arginine, serine, ornithine and cystine. Alanine, glutamic acid, aspartic acid and glycine gave very prominent spots.

Thanks are due to Dr. K. K. Nayar for his help in procuring the venom.

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#### FLAVONOIDS OF THE FLOWERS OF *DOMBEYA CALANTHA* AND *LEUCAENA GLAUCA*

IN recent years, the flavonoid compounds<sup>1</sup> have attracted much attention of organic chemists and there has also been some special interest in the isolation of these compounds having specific physiological activities.<sup>1,2</sup> Seshadri and co-workers<sup>3</sup> had earlier described the separation and characterization of anthoxanthin pigments present in a number of Indian plant materials. In and around Pondicherry, besides the common flora found in other parts of South India, certain plants not native to this area, are cultivated in the gardens. In continuation of our earlier work<sup>4,5</sup> and adopting the well-established methods,<sup>3</sup> the flowers of *Dombeya calantha*, *Leucaena glauca*, *Gliricidia sepium* and *Pithecellobium dulce* have been studied for their flavonoid pigments and the results are now reported in brief.

##### 1. *Dombeya calantha*

Fresh petals of *Dombeya calantha* Schum., collected during December 1961, were extracted thrice with 95% alcohol by cold maceration lasting for 24 hours and the combined extract concentrated *in vacuo* to a small volume. The aqueous alcoholic concentrate was shaken with petroleum ether and ether in succession. The

ether extract was washed with a little water, dried over anhydrous sodium sulphate and concentrated. The ether concentrate on paper chromatography indicated the presence of k  mpferol only as the free flavonol.

The aqueous alcoholic layer was subjected to the lead salt treatment employing neutral and basic lead acetate successively and thus the mixture of glycosides was separated into two fractions. The alcoholic solution of the glycoside from the neutral lead salt fraction after decomposition with hydrogen sulphide, on concentration and keeping in an ice-chest for a week deposited yellow crystalline solid which after recrystallization from methanol came out as yellow needles, m.p. 216–18,<sup> </sup> yield 0.2%. This was identified as isoquercitrin and the identity fully confirmed by comparison with an authentic sample of the compound. In the basic lead salt fraction, the presence of a 3-glycoside of k  mpferol was indicated, but owing to the poor yield, the glycosidic pigment could not be isolated in a crystalline state. On acid hydrolysis, k  mpferol was obtained whose identity was fully established by comparison with an authentic sample.

## 2. *Leuc  na glauca*

Fresh flowers of *Leuc  na glauca* Benth., a small tree with pale-yellow flowers in dense globose heads, collected during October–November 1961, were extracted with 95% alcohol in the cold and the aqueous alcoholic concentrate shaken with ether to remove the free flavonols. The residue from the ether layer on paper chromatography and exposure to ammonia indicated the presence of quercetin, quercetagenin and patuletin. The crude mixture of the pigments from the ether concentrate was chromatographed on large filter-paper sheets according to the method of Anyos and Steelink.<sup>6</sup> The separated zones were cut and the pigments eluted with hot acetone. The first zone was found to be mainly quercetagenin with traces of quercetin, and the second and third mainly quercetin with traces of patuletin, which were further studied by paper chromatography with different solvent systems.<sup>7</sup> Quercetagenin was characterised by its characteristic colour changes with alkaline solutions of different pH values and direct comparison and co-chromatography with an authentic sample. The identity was further established by preparing its acetate, m.p. 208–09  C.; mixed m.p. with an authentic sample of quercetagenin hexa-acetate was undepressed. The identity of patuletin was established by comparing the R<sub>f</sub> values in dif-

ferent solvent systems with those reported earlier.<sup>7,8</sup>

From the aqueous alcoholic layer after ether extraction, only isoquercitrin could be isolated through the neutral lead salt. The total yield of the pigments was about 0.3%.

## 3. *Gliricidia sepium*

Fresh flowers of *Gliricidia sepium* (Syn. *G. maculata*), a small tree bearing purplish-flowers (cultivated for its green manure), collected during January–February 1962 were found to contain small amounts of quercetin and k  mpferol in the free state. The glycosidic pigment was found to be isoquercitrin only which could be obtained in a crystalline form (yield 0.06%).

## 4. *Pithecellobium dulce*

Fresh flowers of *Pithecellobium dulce*, Benth., a large stately tree with ivory white flowers collected during January 1962 contained only isoquercitrin (yield 0.10%) with no free flavonol.

The constituents of the flowers of *D. calantha*, *G. sepium* and *P. dulce* are of common occurrence in many flowers. The co-occurrence of quercetin and its 3-glycoside with quercetagenin and patuletin in *L. glauca* is significant from the point of view of biogenesis of flavonoids. Quercetin is rarely found together with quercetagenin, although its co-occurrence with gossypetin (an isomer of quercetagenin) is common. A similar and rare association of the glycosides of quercetagenin, quercetin and luteolin was earlier reported by Anyos and Steelink<sup>6</sup> in *Chrysanthemum coronarium*. It may also be mentioned that Tominaga<sup>9</sup> had earlier reported on the isolation of quercitrin from the leaves of *L. glauca*.

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### SERUM BILIRUBIN AND ICTERIC INDEX VALUES IN CATTLE AND SHEEP IN EXPERIMENTAL LANTANA POISONING

*Lantana camara* Linn., a native of tropical America, is completely naturalized in many parts of India.<sup>1</sup> The plant has an unpalatable character<sup>2</sup> and contains a toxic photodynamic principle.<sup>3</sup> As lantana shrubs grow in abundance even under scarcity conditions, cases of livestock poisoning by this plant are frequent.<sup>4</sup>

Studies in experimental lantana poisoning by various workers include observations on the post-mortem pathological changes in cattle,<sup>5</sup> changes in physiological norms of buffaloes<sup>4</sup> and haematological and urinary changes in cattle, sheep and goats.<sup>6</sup> It was desired to evaluate the icterus observed in lantana poisoning in quantitative terms, and observations on the serum bilirubin and icteric index values of affected cattle and sheep are presented below:—

Nine Kumaoni bulls and three sheep were selected from herds normally maintained on scheduled standard rations consisting of a dry roughage, green grass and a concentrate mixture. About two pounds of green lantana-leaves, fruits and flowers were intimately mixed with the concentrate quota of each of the bulls which were light or dark skinned and were kept in shade or regularly exposed to the sun for three to four hours daily as per details in Table I. The animals were observed to lose appetite and were completely off feed from the third day onwards. The administration of lantana leaves was, however, continued till the death of the animals in the form of a drench of an aqueous suspension of half a pound of the powder of shade material, to each bull. The animals developed oedema of the face, dermatitis and jaundice in the course of two to four weeks of drenching and death supervened in 32 to 67 days after the commencement of the experiment. Each of the three adult white sheared sheep were similarly drenched with about two ounces of powdered leaves daily till death within 11 to 31 days.

The blood sera of these animals were examined for bilirubin<sup>7</sup> and icteric index<sup>8</sup> (the latter also being generally a measure of the former<sup>9</sup>) values before the start of the experimental feeding and also in the last week of life when the animal was nearing its end.

TABLE I  
Serum bilirubin and icteric index values in cattle and sheep in experimental lantana poisoning

Animal			Icteric Index			Serum bilirubin mg./100 ml.			Superven- tion of death (days)
Number	Colour	Exposed to sun?	Initial	Last week of life	Intermediate stages	Initial	Last week of life	Intermediate stages	
1	2	3	4	5	6	7	8	9	10
CATTLE									
68	Black	Yes	34.3	65.0	..	..	6.55	..	37
170	do.	do.	30.6	92.7	90.0	..	4.22	1.10, 6.45	55
207	do.	No	28.8	144.0	109.9	..	4.48	1.95, 5.41	59
28	White	do.	28.9	144.3	27.3, 70.8, 95.7	0.14	10.37	0.21, 8.33, 8.89	67
357	Grey	Yes	25.3	170.1	92.7	0.34	4.35	5.84	54
29	White	do.	53.6	129.3	24.0, 61.2, 112.8	0.29	10.76	0.33, 1.35, 9.29	67
403	Grey	do.	..	102.3	..	..	8.83	..	35
750	do.	do.	..	117.4	..	..	9.70	..	32
757	White	do.	..	111.2	102.3	..	10.03	9.70	42
Average		..	28.6	119.6	..	0.26	7.70	..	50
SHEEP									
1	White	Yes	*	25.4	..	0.34	0.64	..	31
2	do.	do.	*	38.8	..	0.34	6.84	..	19
3	do.	do.	*	123.9	..	0.34	8.17	..	11
Average		..	..	64.0	..	0.34	5.22	..	18

\* The serum was almost colourless,



A few observations made at successive intermediate stages during the period of experimentation, are also included in Table I.

The data presented in Table I reveal that the final values of serum bilirubin and icteric index in both cattle and sheep show a marked rise over the initial values which pertain to normal animals. Cattle on dry feeds have almost a colourless plasma but due to the pigmentation of plant origin the colour may measure up to 25 units on the icteric index scale.<sup>10</sup> In sheep, unlike in cattle, the plasma colour is not affected by the yellow pigments of the ration<sup>11</sup> and the icteric index does not normally exceed 5 units.<sup>10</sup> The parallelism in the rising tendency in both the values during the progress of the malady is generally very close. The change in the serum bilirubin content is, however, a better index of the severity of the disease than the icteric index which in some species is influenced by carotene and other pigments.<sup>9-11</sup>

The normal serum bilirubin values in mg. % in cattle and sheep as averaged on the basis of the present data are 0.26 (range 0.14 to 0.34) and  $0.34 \pm 0.0$  respectively. These values rise to 7.70 (range 4.22 to 10.76) and 5.22 (range 0.64 to 8.17) respectively when the clinical symptoms of jaundice and photosensitisation in animals advance to a critical stage. Garner,<sup>12</sup> who observed a maximum serum bilirubin content of 3.5 mg. % in generalised liver disease in bovines, has recorded a high figure of 7.7 mg. % in one of the two animals suffering from haemolytic jaundice, a condition in which an excessive rate of breakdown of red blood cells takes place.<sup>13</sup> Extremely low values for red blood cells and haemoglobin have also been recorded by Sharma<sup>6</sup> in experimental lantana poisoning and by Prasad<sup>14</sup> in suspected lantana poisoning. Done *et al.*<sup>15</sup> in field cases of facial eczema photosensitisation in sheep observed that the severity of liver damage was related to the extent of the increase in certain serum constituents including bilirubin, the values for which in 25 sheep showing icterus ranged from 0.60 to 13.6 mg. % as against the range of 0.4 to 0.9 mg. % in six normal sheep.

The abnormality of the appearance of a precipitate on freezing and thawing in sera from severe cases of facial eczema<sup>15</sup> was also observed in sera obtained from animals after about two weeks of continuous drenching of the aqueous suspension of lantana powder.

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### SOME NEW PROBABLE SOURCES OF FRUCTOSANS

IN sequel to our investigations on the stem of *Agave Vera Cruz*, which was shown to be a rich source of fructosans,<sup>1-3</sup> we looked for this polysaccharide in some more indigenous plants as possible raw materials for the production of fructose. For exploratory work we made use of the Seliwanoff's test. To keep out interfering substances like sucrose, the materials were first extracted with 70% alcohol and the test carried out on the extracted residue. Thus, the presence of fructosans was indicated in the following: (i) *Arisema leschenaultii* (Arecaceae) corm; (ii) *Cheiranthus* species (Cruciferae)—pods; (iii) *Coleus barbatus* (Labiatae)—fruiting calyx; (iv) 3 varieties of *Habenaria* species (Orchideae)—root stocks and capsules; (v) *Impatiens* species (Balsaminaceae)—pods; (vi) *Lilium neilgherrense* (Liliaceae)—bulbs; and (vii) *Polianthes tuberosa* (Amaryllidaceae)—tubers.

As this presumptive evidence has been borne out experimentally by paper chromatographic procedures and by isolation of fructosan from

*Polianthes tuberosa*,<sup>4</sup> Seliwanoff's test, where it is positive under the conditions as prescribed here, can therefore be taken to be fairly reliable. On this basis, some of the plant species now to be considered to contain fructosans belong to natural orders not earlier tested among the fructosan group (cf. Whistler and Smart<sup>5</sup>).

A detailed survey might reveal that the distribution of fructosans in the plant kingdom may be much more general than has been assumed so far.

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## ANTHOXANTHIN PIGMENTS OF TAMARIND

THE presence of the anthocyanin, chrysanthemin in a red variety of tamarind, and leucocyanidin in the common variety has been reported earlier from these laboratories.<sup>1</sup> At that time it was noticed that chromatograms run for anthocyanins showed yellow spots also, which turned bright yellow on exposure to ammonia, characteristic of anthoxanthins. Results of investigations into the nature of these pigments are reported here.

Leaves were found to be richest in anthoxanthin pigments, giving a yield of about 2% on dry weight. Almost the entire yellow colour of the flowers was found to be due to xanthophylls. The fruits also were poor in anthoxanthin content. The leaf extract has been in use in India since ancient times as an indigenous dye for silk and woollen fabrics.<sup>2</sup> Leaf extract is also the most potent of all Indian medicinal preparations from tamarind, for use as diuretic, antiseptic, anthelmintic, etc.<sup>3</sup> The physiological action of bioflavonoids is well recognised,<sup>4</sup> and, no doubt the potency of tamarind leaf preparations is due to these.

The pigments could be extracted from concentrated water extract of the leaves, using ethyl acetate or Amberlite IRC-50 resin.<sup>5</sup> For large-scale preparations, the former method

was used. After removal of ethyl acetate by distillation, and taking up the residue in alcohol, a bright yellow powder separated from the concentrated solution of pigments. This was washed with alcohol and dried. (Yield, about 10%.) This bright yellow powder showed two yellow bands on chromatograms run with butanol-acetic acid-water (4 : 1 : 5), or 15% acetic acid as solvent. The supernatant liquid showed two more bands in addition to these. The pigments were soluble in water and insoluble in ether, showing their glycosidic nature. Hydrolysis of the solution of pigments with 7% sulphuric acid for 2-24 hours, however, produced only a small quantity of ether-extractable colour. The glycosides and aglycones were isolated quantitatively by separation on vertical chromatograms run with 15 and 60% acetic acid respectively, and eluted from cut strips with 80% alcohol according to the technique described by Gage and Wender.<sup>6</sup> The operation was repeated with individual bands for purification. Because of the difficulty of hydrolysis, aglycone material obtained was sufficient only for chromatographic and absorption spectra studies. The data collected on the properties of the individual bands are given in Table I.

TABLE I  
Characteristics of tamarind anthoxanthins

Bands	RF			Colour in		Melting Point 0° C.	U.V. absorption maxima
	BAW	15% Acetic	Phenol Water	U.V.	U.V + NH <sub>3</sub>		
Glycosides							
I	0.40	0.19	0.52	Br	YGr	257	258; 349
II	0.57	0.28	0.68	Br	YBr (decomp.)	263	270; 335
III	0.52	0.40	0.76	Br	YBr	..	260; 350
IV	0.68	0.51	0.82	Br	YBr	200	272; 336
Aglycones 60% Acetic							
I	0.79	0.63	0.70	Br	GY	..	258; 350
II	0.88	0.77	0.87	Br	Y	..	269; 340

BAW = Butanol-acetic acid-water (4 : 1 : 5).

Br = Brown; Y = Yellow; G = Green.

The ultra-violet absorption maxima, colour reactions and RFs in different solvent systems of the aglycones point to their being the flavones, Luteolin and Apigenin (Bands I and II), by comparison with recorded data.<sup>7,8,10</sup> The data for glycosides also agree broadly with some individual glycosides of the two flavones, e.g., Band I—Luteolin-7-monoglucoside (M.P. 258° C.), Band II—Apigenin-rhamnoglucoside (M.P. 265° C.—decom.).<sup>7,8,10</sup> However, the poor hydrolysa-

bility of the glycosides is intriguing and makes positive identification very difficult. It is probable that they are stable stereoisomers of the glycosides or glycosides where the sugar residue is attached to the pigment nucleus by a carbon-carbon bond as in barbaloin (Dr. K. Venkataraman, personal communication).

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## GEOCHEMISTRY OF WATERS AT THE URANIUM PROSPECT AT UMRA, RAJASTHAN

With the object of investigating the geochemistry of the natural waters at the uranium prospect at Umra, Rajasthan, the concentrations of uranium, nickel, cobalt, copper, vanadium, calcium, sodium and potassium in the natural waters have been determined and their distribution patterns have been interpreted in the light of the geology of the area, the climatic and hydrological conditions prevalent there and the geochemical behaviour of the elements concerned.

The stratigraphic succession of the uranium belt and the pattern and controls of mineralisation of copper and uranium were given by Dar and Nandi.<sup>1</sup>

The concentration of various elements have been determined by the methods noted against each in Table I.

TABLE I

Sl. No.	Elements	Instrument used for analysis	Method
1	Uranium	Fluorometer	Geier and Holland <sup>2</sup>
2	Sodium, potassium and calcium	Flame photometer	Lillie Jenkins <sup>3</sup>
3	Copper, cobalt, nickel and vanadium	Spectrophotometer	Sandell <sup>4</sup>

The analytical data are given in Table II.

TABLE II

Umra-water samples, location and chemical data:

Sl. No.	Sample No.	Location E. Long. & N. Lat.	Depth of water-table (for wells)	Concentration					
				U in ppb.	Cu%	Co%	Na <sub>2</sub> O%	K <sub>2</sub> O%	CaO%
1	UM-1	73° 46' 35.1"	30'-40'	3.4	8.0 × 10 <sup>-5</sup>	1.0 × 10 <sup>-6</sup>	38.3	32	n.d.
		24° 31' 7"							
2	UM-2	73° 46' 32.3"	60'-70'	19.1	5.0 × 10 <sup>-5</sup>	1.0 × 10 <sup>-6</sup>	4.2	2.83	4.37
		24° 31' 29"							
3	UM-3	73° 46' 54"	50'-60'	2.6	9.0 × 10 <sup>-5</sup>	16.5 × 10 <sup>-6</sup>	7.6	2.00	19.87
		24° 31' 3"							
4	UM-4	73° 46' 8.3"	60'	6.0	61.0 × 10 <sup>-5</sup>	4.0 × 10 <sup>-6</sup>	16.04	2.00	6.95
		24° 31' 11"							
5	UM-5	73° 46' 47.8"	50'	22.8	57.0 × 10 <sup>-5</sup>	1.0 × 10 <sup>-6</sup>	5.91	2.00	4.37
		24° 30' 7"							
6	UM-6	73° 46' 8.1"	50'	49.5	53.0 × 10 <sup>-5</sup>	4.0 × 10 <sup>-6</sup>	9.29	2.00	6.95
		24° 30' 13"							
7	A <sub>3</sub> W <sub>1</sub>	Adit No. 3	..	1,554.5	1.0 × 10 <sup>-5</sup>	..	32.01	5.32	8.25
		Winze No. 1							
8	A <sub>3</sub> W <sub>2</sub>	Adit No. 3	..	6,495.5	13.0 × 10 <sup>-5</sup>	..	24.49	2.00	2.44
		Winze No. 2							
9	A <sub>3</sub> W <sub>3</sub>	Adit No. 3	..	5,455.5	5.5 × 10 <sup>-5</sup>	8.0 × 10 <sup>-6</sup>	23.64	2.00	1.79
		Winze No. 3							
10	S <sub>2</sub>	Shaft No. 2	..	6,495.5	65.0 × 10 <sup>-5</sup>	1.0 × 10 <sup>-6</sup>	13.50	2.00	3.08

N.B.: UM-1 to UM-6 are well-waters; Vanadium and nickel are absent in all samples.

The principal conclusions of the study are as follows:—

(1) There is a marked contrast in the uranium content of winze and well-waters.

(2) The presence of copper in waters despite their high pH (7.5–9.0) is ascribed to the tendency of copper to form colloidal suspension of basic carbonates.

(3) The observation that vanadium is present in the secondary uranium-vanadium minerals but is absent in the waters, could be explained in terms of the distinctly different solubilities of trivalent and quinquivalent states of vanadium.

(4) The concentration of cobalt in most of the water samples and its absence in some is traceable to the controlling effect of pH on the mobility of cobalt.

(5) Nickel in waters might have been 'scavenged' and adsorbed on hydrated iron oxides, which explains the absence of nickel in waters.

(6) Mention is made of the health hazard involved in drinking water from one of the wells (UM-6) with high content of uranium.

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## THE FORESET AND BACKSET BEDS IN THE PACHMARHI FORMATION

THE cross-laminations have been widely utilized for the study of palæocurrents. The Pachmarhi sandstones of the Upper Gondwanas are exposed in a lensoid outcrop on the northern slopes of the Satpuraz. This formation is the lowermost stage of the Mahadeva series.

The whole arenaceous deposit is full of cross-beds. These are well shown on the vertical sections exposed along the Pipariya-Pachmarhi Road. The various cross-laminations in each coset (term due to McKee and Weir, 1953) have been carefully measured for the two parameters angle and direction of inclination. Within each coset, bounded by pebbly layers, are cross-beds ranging in thickness from a few inches to three feet. The angles of inclination vary from 15° to 45°.

It is generally admitted that the inclination of the beds points to the direction of the current flow. In some places in Pachmarhi, there are cross-beds which dip opposite to the general pattern and are thus inclined against the direction of the current flow. Such cross-beds are termed "Backset beds" by Power Jr. (1961), in contrast to the term foreset for the cross-beds, inclined in the same direction as that of the current.

TABLE I

Locality*	No. of observation		Direction of dip		Amount of dip. (in °)
	Foresets	Backsets	Foresets	Backsets	
31/8	1	..	NNW	..	..
31/7	1	..	WNW	..	35
31/6	1	1	ENE	WSW	15–40
31/5	1	1	E	W	15
31/4	1	..	E	..	30
31/3	4	..	N 10° W	..	30
31/3	1	..	N	..	10
30/6	13	..	NNW	..	30
30/4	8	..	N 10° W	..	..
29/8	2	..	N	..	30
29/7	1	1	NNE	SSW	40
29/5	10	2	E	W	20
27/7	6	1	E	W	25
26/8	1	..	N	..	30

\* Numbers refer to miles and furlongs on Pipariya-Pachmarhi Road.

In common descriptive terms, the cross-beds in the Pachmarhi formation, which is undoubtedly aqueous, may be described simply as Torrential, Regular or Angular all terms implying deposition by water. These are cross-strata that in section appear as straight lines meeting the underlying surface at high angles. When the lower bounding surface is a planar

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surface of erosion, the cross-strata are called "Planar" by McKee and Weir (1953). The writer proposes "Planar angular" as a term for these,—a term implying genesis and also found in McKee and Weir's classification.

Figure 1 shows the direction of 50 cross-beds with two strong peaks one to the north and the other to the east. The small number of sets inclined westwards are the backsets. Figure 2 shows the histogram with angle of inclination on the horizontal axis and number of observations on the vertical axis.

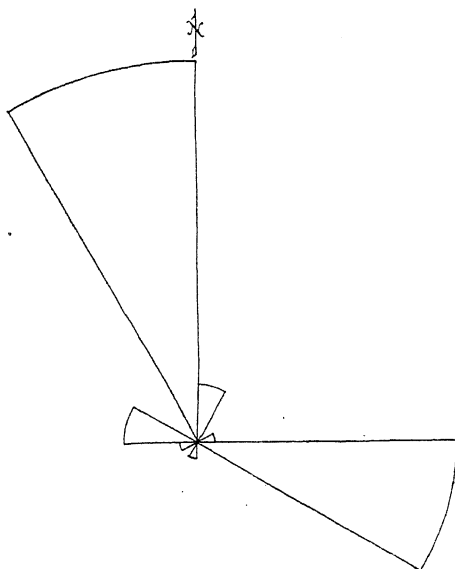


FIG. 1

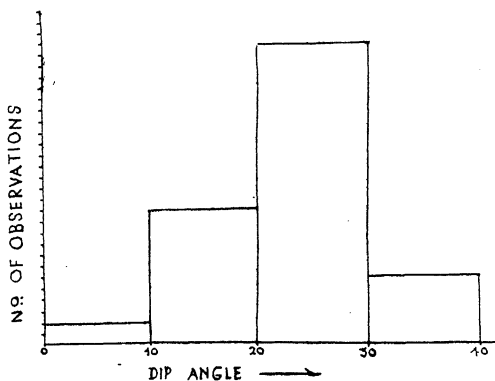


FIG. 2

The scale and steepness of the cross-beds are a function of current velocity and rate of supply of material. The thickness of cosets is about 3' in general with 20°-30° inclination and suggests a moderately fast current velocity. The

orientations of the structures (Fig. 1) point to a major current movement towards the north. There was undoubtedly some variation in the direction when foresets inclined towards the east and backsets inclined towards the west may have been deposited.

The nature and origin of the backsets have not been investigated as yet. Their presence, however, has been noted by Twenhofel (1939) and more recently by Power Jr. (1961). The latter author quotes Gilbert (1914), who found an "antidune" phase of transport in heavily overloaded streams, to explain the origin of these peculiar backset beds. The detailed study of more such occurrences, may throw more light on the nature of this type of cross-laminations.

I thank Dr. S. C. Chatterjee for his kind encouragement.

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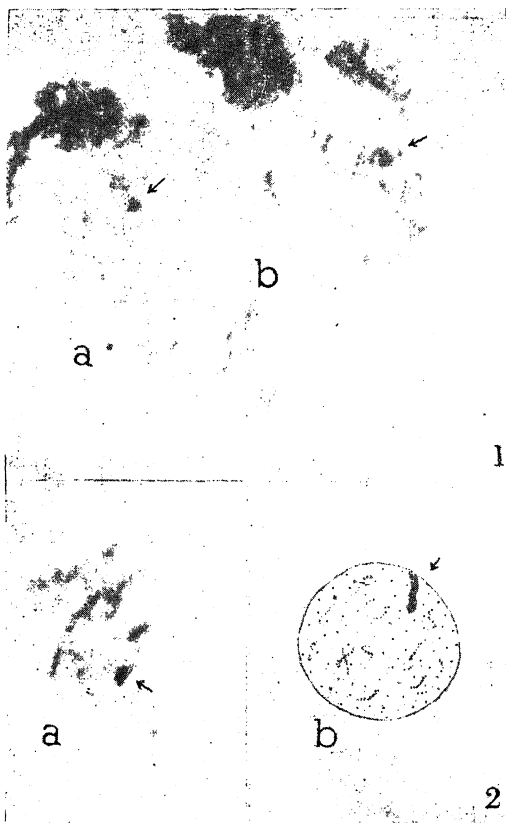
## THE ORIGIN OF SEX CHROMATIN

SEX CHROMATIN has now come to be recognized as an indication of sexual dimorphism in the interphase nuclei of normal and malignant tissues of many mammals including man. The sex chromatin is a planoconvex body, generally adhering to the nuclear membrane and confined to the female sex. The relationship between this body and the chromosomes has always been an interesting problem.

Sex chromatin is believed to be due to the fusion of heterochromatic regions of the two sex chromosomes.<sup>1-5</sup> The presence of a longitudinal split observed in sex chromatin lent support to this view. However, that sex chromatin is derived from only one of the two X-chromosomes has also been held.<sup>6-9</sup>

In view of the divided opinion on the origin of sex chromatin the following observations on this structure would appear to be of interest. C3H mouse mammary adenocarcinoma as well as human normal endometrium in proliferative stage served as material for this study. The tissues were fixed in Acetic alcohol (1:3), and Feulgen and aceto-orcein squashes were made.

Sex chromatin in interphase nuclei of these tissues could be easily recognized as a plano-convex body adherent to the nuclear membrane (Figs. 1a, 2a). It was possible to trace this structure during the mitotic cycle in both tissues. At prophase, only one of the two X-chromosomes was found to be heteropycnotic (Figs. 1b, 2b). In metaphase, however, it was not possible to recognize the X-chromosome since all chromosomes were uniformly stained. Nevertheless, the heteropycnotic nature of the single X-chromosome became evident again during anaphase. It is this that became later the sex chromatin of the interphase nucleus. It is clear that the sex chromatin in this material is derived from only one of the two X-chromosomes.



FIGS. 1-2. Fig. 1a. Interphase nucleus showing (arrow) the sex chromatin lying against the nuclear membrane,  $\times 4,000$  (Human normal endometrium; Aceto-orcein). Fig. 1b. Prophase nucleus showing (arrow) a single heteropycnotic sex chromosome,  $\times 4,000$ . (Human normal endometrium; Aceto-orcein.) Fig. 2a. Interphase nucleus showing (arrow) a feulgen positive sex chromatin lying against the nuclear membrane,  $\times 4,000$ . (C3H mouse adenocarcinoma). Fig. 2b. Camera lucida drawing of the early prophase nucleus showing a single feulgen positive heteropycnotic sex chromosome,  $\times 4,000$  (C3H mouse adenocarcinoma).

One of the interesting problems raised by the above observations relates to the origin of the single heteropycnotic X-chromosome; whether it is derived from the female gamete or from the male gamete at the time of fertilization. Studies on this aspect as well as on the sex chromatin of other mammals are in progress.

My grateful thanks to Professor B. R. Seshachar, Department of Zoology, University of Delhi, for discussions and criticisms. Part of the work was done during the author's stay at the Cancer Institute, Madras.

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#### CYTOLOGICAL DIFFERENTIATION OF VARIOUS STAGES OF MATURITY IN THE INDIAN MAJOR CARP *CIRRHINA MRIGALA* (HAM.) WITH PARTICULAR REFERENCE TO THE ORIGIN AND FATE OF VACUOLES IN THE OOCYTES

CYTOLOGICAL studies on the progressive changes that take place in oocytes during maturity have, in recent years, assumed considerable importance particularly in case of cultivable fishes which naturally do not spawn in confined waters. A further understanding of the histochemical and histophysiological processes involved in maturation will undoubtedly advance our knowledge of the process of development of gonads and reproduction. Several workers have classified the different stages of gonadal maturity based on morphological<sup>1,2</sup> and histological<sup>3</sup> characters. No recorded observations on the cytological features that characterise different stages of maturity are, however, available and hence the present attempt to distinguish different stages of maturity of the ovary of *Cirrhina mrigala* based on cytological characters.

1st Stage :—

In the earliest stage, in oocytes measuring  $12\mu$  to  $60\mu$  in diameter, the mitochondria and Golgi bodies are restricted to the circum-nuclear region (Fig. 1).

2nd Stage :—

In oocytes measuring  $60\mu$  to  $80\mu$  sudanophilic bodies, viz., mitochondria and Golgi bodies, are distributed uniformly, in the cytoplasm and no definite cellular follicular epithelium is differentiated.

3rd Stage :—

Invaginations of the vitelline membrane appear into the cytoplasmic area (Fig. 2). Later, these invaginations constrict at the bases separating the distal portions as free vacuoles in the cytoplasm. A large number of such vacuoles, arranged more or less, in two concentric circles, appears in the middle of the cytoplasmic area at this stage, when the oocytes measure between  $80\mu$  and  $130\mu$  in diameter (Fig. 3). The occurrence of such vacuoles in animal cells was noted by many workers.<sup>4</sup> Singh and Boyle<sup>5</sup> thought that the granular nuclear extrusions 'acquire' the vacuoles around themselves. The present study along with the observations of Nath *et al.*<sup>6</sup> tends to disprove the above observation.

These vacuoles are non-lipoidal in nature, as indicated by negative Sudan black B test and remain so till the end. The vacuolar contents, if any, at this stage are negative to tests for proteins, carbohydrates, as well as for lipids.

4th Stage :—

More numerous vacuoles of larger sizes are observable in the cytoplasm. The vacuoles at this stage contain—probably secrete—some material which is made up of acid mucopolysaccharides, as it gives metachromatic reaction in Toluidine blue and is stained blue in Alcian blue. Yolk bodies which are lipoidal in nature appear below the follicular epithelium and in between the vacuoles (Fig. 4). The size of the oocytes of this stage is  $130\mu$  to  $450\mu$  in diameter.

5th Stage :—

The yolk bodies are observed to increase in size and number and simultaneously a reduction in size of the vacuoles is noticed. Considering this decrease in size, number and contents of the vacuoles and simultaneous increase in size and number of yolk bodies, it is probably not unreasonable to assume that the vacuolar material may supply nourishment to the developing yolk bodies. The vacuoles start migrating towards the periphery and the size of the oocytes at this stage is  $450\mu$  to  $780\mu$  in diameter.

6th Stage :—

The yolk bodies have grown to their maximum size, filling up the entire cytoplasm and consequently pushing the vacuoles to the periphery. At this stage the vacuoles lie along the periphery of the cell in a single layer and are devoid of any contents (Fig. 5). The size of the oocytes of this stage varies between  $780\mu$  and  $1,092\mu$  and this represents the ultimate size, the ova attain prior to being shed.

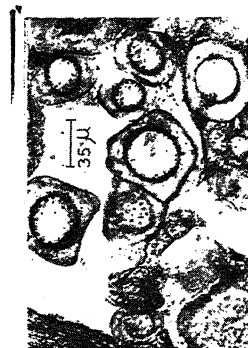


FIG. 1.

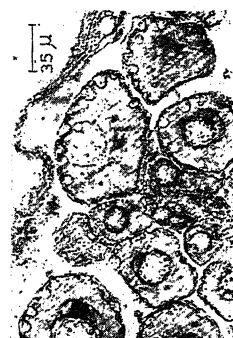


FIG. 2.

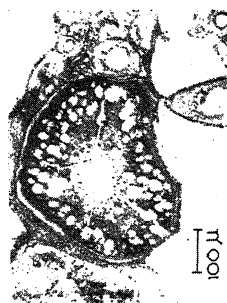


FIG. 3.

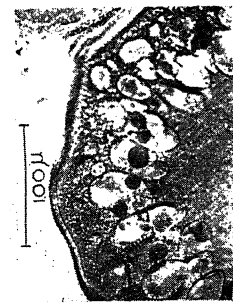


FIG. 4.

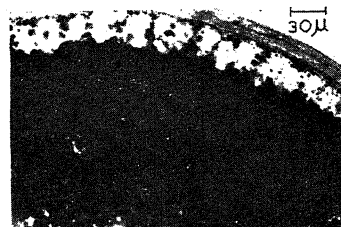


FIG. 5.

FIGS. 1-5. Photomicrographs of sections of ovaries showing the oocytes with (1) circumnuclear concentration of mitochondria and Golgi bodies; (2) inward vacuolar pushings from the vitelline membrane; (3) migration of vacuoles to the middle of the cytoplasm; (4) presence of secreted material in the vacuoles and the appearance of yolk bodies; and (5) peripheral arrangement of the empty vacuoles.

Grateful thanks are due to Dr. B. S. Bhimachar, Director of the Institute, and Shri. V. R. Pantulu for their keen interest and guidance.

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### STRAIN VARIATIONS IN *PSEUDOMONAS SOLANACEARUM* THE BACTERIUM CAUSING BROWN- ROT OF POTATO IN SOUTH INDIA

THE Nilgiris in Madras State and parts of Mysore State are the important potato tracts of South India. *Pseudomonas solanacearum* E.F. Sm., the causal bacterium of brown-rot disease of potato, is known to occur in these areas for many years now.<sup>1</sup> Mann and Nagpurkar<sup>2</sup> and Patel *et al.*<sup>3</sup> studied the bacterium and identified it as *Ps. solanacearum*. According to Hingorani *et al.*,<sup>4</sup> the bacterium causing brown-rot of potato in Madras and Mysore States is *Ps. solanacearum* var. *asiaticum* (E.F. Sm.) Stapp. The same bacterial variety has also been reported from Bengal, Bihar and Assam.<sup>4,5</sup> With a view to examine in detail the causal bacterium occurring in South India,

brown-rot-affected potato tubers were collected from the fields in the Nilgiris and near Bangalore and also from the vegetable market in Chidambaram, S. Arcot. The tubers come to the Chidambaram market mainly by road from the borders of Mysore, adjoining Madras State. Several isolations of the causal bacterium were made from each of the three sets of specimens and representative types were selected for the comparative studies. Firstly, their pathogenicity was tested by the usual wound inoculation method into healthy tubers. The sprouts developing from the inoculated tubers invariably carried the infection, but there was no difference in disease symptoms caused by the three bacterial isolates.

The bacteria were then studied for their morphological, cultural and physiological properties. Their characters mostly conformed to the species description given by Breed *et al.*<sup>6</sup> They were also mostly identical in their capacity to utilise various carbon and nitrogen sources. Between the three isolates certain differences in the cultural and physiological properties were, however, observed and they are summarised in Table I.

The differences between the Nilgiri isolate and the other two are more marked than those between the Bangalore and Chidambaram isolates. Smith<sup>7</sup> differentiated the variety *asiaticum* from *Ps. solanacearum* on the basis of its ability to coagulate litmus milk, with pink discolouration and acid production. On this account the Nilgiri isolate could be classified as *Ps. solanacearum* var. *asiaticum*. The other two isolates differ distinctly in their colony colour and in the growth characters in litmus milk. But these differences do not form sufficient ground

TABLE I

A comparison of the characters of three isolates of *Ps. solanacearum* from S. India

Character	Chidambaram isolate	Nilgiri isolate	Bangalore isolate
Growth on nutrient agar	Rhizoid, flat, lobate, dull white, slimy	Rhizoid, raised, lobate, white, slimy	Rhizoid, flat, lobate, creamy-white, turning to white, not slimy
Growth in nutrient broth	Turbid with pellicle formation	Turbid with ring formation	Turbid with flocculation
Growth on potato plug	Yellowish-white, non-glistening	Brownish-white, glistening	Creamy-white, glistening
Growth in litmus milk	Peptonized, but not coagulated, alkaline	Peptonized, coagulated, acid with pink colour	Peptonized, coagulated, alkaline
Nitrate reduction	Positive	Negative	Positive
Thermal death-point	53° C.	55° C.	53° C.



to create new varieties to classify them and so they may be included as strains of *Ps. solanacearum*. Similar strain variations in the isolates of the bacterium from North India were reported by Hingorani *et al.*<sup>4</sup> and Vasudeva.<sup>8</sup> These studies reveal the prevalence of more than one type of the bacterial species in South India.

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#### GENETICS OF COLOUR VARIATION IN RED COTTON BUG, *DYSDERCUS KOENIGII* (FABRICIUS)

DURING the course of investigations on the ecology of red cotton bug, *Dysdercus koenigii* (Fabricius) belonging to Pyrrhocoreidae (Heteroptera), a few individuals with conspicuous grey body colouration without any tinge of redness were noticed among the normal deep red nymphs of the 3rd instar. The grey nymphs were isolated and allowed to complete development at 30° C. at which they were initially noticed; the emerging adults were ochraceous in general appearance unlike the normal red bugs. On breeding it was observed that their progeny bred true for the parental body colour. The observations on genetic determination of two types of body colour are reported herein.

The colour variants differ from the normal red types at various stages of their growth. Their eggs remain white and 1st instar nymphs creamish-white throughout, whereas the eggs of the normal ones are light yellowish-white when laid, becoming orange before hatching, their 1st instar nymphs are orange in the beginning, becoming red within 24 hours. The abdomen of the 2nd instar nymphs of the

former is light grey when freshly moulted, becoming deep grey within 24 hours, whereas the abdomen of those of the latter is red throughout. The head, thorax, femora and anterior portions of wing pads of nymphs of 3rd, 4th and 5th (Fig. 1) instars of the colour variants

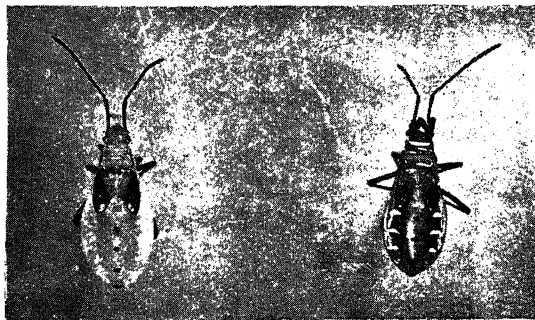


FIG. 1. 5th instar nymphs of *D. koenigii*. Left: Grey colour variant. Right: Red normal.

are ochraceous-buff and their abdomen deep grey, whereas all these parts of the normal ones are red. Freshly moulted adults of the former are greyish-white in general appearance, those of the latter light reddish-brown; the antennae and legs of the former are white while those of the latter deep red; and the wings, excepting membranous portion, of the former are greyish-white but those of the latter orange. A few hours after moulting when complete adult colouration has developed the general appearance of the former adults is ochraceous-buff against deep red of the latter ones. Thus it is the grey colour of abdomen during nymphal stages of the colour variant which is most conspicuous and that is why this character has been used for the purpose of genetic analysis.

In order to determine the genetic basis of the observed body colour variation, a number of crosses have been made between the normal red types and the colour variants. The  $F_1$  individuals from all these crosses are found to show red-type body colour, thus indicating its complete dominance over the grey colour. The  $F_2$  progenies have been raised from a number of these  $F_1$  individuals and at the same time two test crosses have been made. The  $\chi^2$  analysis of the  $F_2$  and test-cross data (Tables I and II respectively) show that the red and grey individuals segregate in 3:1 ratio in the case of  $F_2$  and in 1:1 ratio in that of test cross generation; and these segregation ratios indicate that a single gene difference determines red versus grey types of body colour with complete dominance of the allele for red colour.

TABLE I  
*F<sub>2</sub> segregation*

Parental phenotypes	F <sub>2</sub> segregation		$\chi^2$ value for an expected 3:1 ratio	P value
	Red	Grey		
Red × Grey	57	18	0.053	0.90 .. 0.80
Grey × Red	127	42	0.0019	0.98 .. 0.95

TABLE II  
*Test-cross segregation*

Parental phenotypes	Test cross segregation		$\chi^2$ value for an expected 1:1 ratio	P value
	Red	Grey		
Red × Grey	37	39	0.052	0.90 .. 0.80
Grey × Red	14	10	0.666	0.50 .. 0.30

Mutant colours of white,<sup>1</sup> yellow stripe<sup>2</sup> and melanic<sup>2</sup> types determined by recessive mutations have been reported earlier in the case of *Dysdercus urichi* and *D. mendesi*. The present observations on grey type of colour are perhaps the first recorded on *D. kœnigii* and this seems to be probably a recessive mutation which has arisen spontaneously in the culture. Since experimental analysis on the red cotton bug can be conducted conveniently, its well-defined colour variant like the one reported here should make possible its use for genetic studies of fundamental nature.

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**CHENOPODIUM AMARANTICOLOR L.**  
**—A LOCAL LESION HOST FOR TURNIP**  
**MOSAIC VIRUS,**  
**MARMOR BRASSICAE H., FROM**  
**HORSE-RADISH**

HORSE-RADISH (*Armoracia rusticana*) is widely grown in the U.S.A. and Europe for its roots which are used as spice and also for the production of an enzyme, peroxidase. Kadow and Anderson,<sup>2</sup> Novak and Vlk<sup>3</sup> reported the widespread occurrence of a mosaic disease of this crop. Pound,<sup>4</sup> in a survey of the horse-radish-growing areas of the U.S.A., obtained seven isolates and studied the symptomatology, host range, and properties using *Nicotiana tabacum* as a local lesion host. The junior author, in a survey of the horse-radish plantings of Illinois, obtained from a virus-infected horse-radish clone an isolate closely resembling in properties turnip mosaic virus of Tompkins.<sup>5</sup> In a study of the host range of this isolate, Chenulu<sup>1</sup> found that, in addition to *N. tabacum* reported earlier by Pound,<sup>4</sup> infections on *Chenopodium amaranticolor* also produced necrotic local lesions.

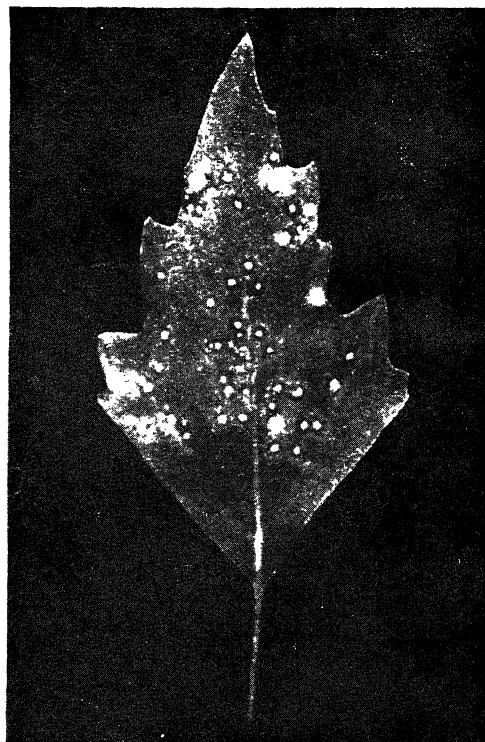


FIG. 1. Necrotic local lesions on *Chenopodium amaranticolor* caused by turnip mosaic virus *Marmor brassicae* H. from Horse-radish (*Armoracia rusticana*).

Since the viral isolate under study produced necrotic local lesions on *N. tabacum* and on *C. amaranticolor*, an experiment was set up to compare the suitability of the two local lesion hosts for the bioassay of this virus. For this purpose, plants of *C. amaranticolor* and *N. tabacum* were inoculated with an infectious extract of the virus obtained from infected leaves of *Nicotiana glutinosa*; a systemic host of this virus. The inoculum, a 1:10 dilution of the infectious crude extract in 0.2M phosphate buffer at pH 8.0, was applied to the upper surface of the leaves with a cheesecloth pad. Inoculated leaves were rinsed with water. The results are given in Table I.

TABLE I

A comparison of *Nicotiana tabacum* and *Chenopodium amaranticolor* for the bioassay of turnip mosaic virus from infected leaves of *N. glutinosa*

Assay plant	Incubation period (days)	Number of local lesions*	Coefficient of variability
<i>N. tabacum</i>	10	29.9	5.8
<i>C. amaranticolor</i>	5	41.2	5.9

\* Average number of local lesions per leaf on a total of 12 leaves.

Although the two assay plants were about equally sensitive to infection, local lesions were produced on *C. amaranticolor* in less time (5 days) than on *N. tabacum* (10 days). Further, in a separate study it was observed that the production of necrotic local lesions on *N. tabacum* was influenced by temperature fluctuations in the green-house, whereas this was not so with *C. amaranticolor*. Therefore, *C. amaranticolor* is preferable to *N. tabacum* as a local lesion host for the bioassay of turnip mosaic virus, *Marmor brassicae* H., from Horse-radish.

Thanks are due to the Department of Plant Pathology, University of Illinois, Urbana, Illinois, for the award of Part-time Research Assistantship to the senior author, from September 1956 to February 1959 during the tenure of which this work was carried out.

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### ROSENSCHELDIELLA EUGENIAE PETCH—A NEW RECORD TO INDIA

PLANTS of *Eugenia heyneana* Duth. growing in the forest area of Mahabaleshwar (4,500 ft. altitude) were found heavily infected with tar-spot lesions during the cold season (Nov.-Feb.) of 1961-62. The infection was confined to the lower side of the leaves and manifested itself in the form of round to oval, cushion-like raised dark lesions. It was particularly interesting to note that the infection was confined to *Eugenia heyneana* Duth. and did not occur on other species of *Eugenia* growing in the vicinity such as *Eugenia jambolana* Lamk., *E. corymbosa* Lamk. The infection spots resembled those caused by *Neobarklaya natalensis* Syd. but were much larger and hypophyllous. A critical examination of the lesions revealed a dothideaceous fungus with multiloculate stroma and paraphysate asci originating in tufts. The fungus was later identified through the courtesy of Dr. E. Muller of the Institute for Special Botany, Zurich, Switzerland, as a species of *Rosenscheldiella* Theiss. et Sydow.

The genus *Rosenscheldiella* was established by Theissen and Sydow (1915) for a dothideaceous fungus collected on *Styrax* species from Brazil with *R. styraxis* (P. Henn.) Theiss. et Sydow as type. Since then four more species have been described, two from Ceylon and one each from Uganda and Cuba. No species of *Rosenscheldiella* has so far been reported from India. A careful comparison was therefore made between the Indian collection of *Rosenscheldiella* and the five species previously reported in literature the results of which showed that while the Indian collection was distinct from the four species of *Rosenscheldiella* reported from Brazil, Cuba, Uganda and Ceylon, it agreed in several respects with *R. eugeniae* Petch collected on *Eugenia sub-avensis* Duth. by Petch (1925) from Ceylon as can be seen from Table I.

These figures show that the Indian collection of *Rosenscheldiella* agrees, in general, with *R. eugeniae* Petch the major differences being

TABLE I

Species	Stroma	Locules	Asci	Ascospores	Authority
<i>R. eugeniae</i> Petch	.. 100-130 × 160 $\mu$ Uniloculate	89 × 100 $\mu$	72-76 × 13 $\mu$	24-32 × 4 $\mu$	Petch, 1925
Indian species	.. 545-1285 × 109-145 $\mu$ Multi-loculate	57 × 96 $\mu$	60-77 × 10.5 $\mu$	26-34 × 6 $\mu$	..

in the nature and multiloculate characters of the stroma, thinner asci and broader ascospores. These differences, however, are not considered significant enough to justify description of the Indian collection as a new taxon. Accordingly, the Indian collection is referred to *Rosenscheldiella eugeniae* Petch as described by Petch (1925).

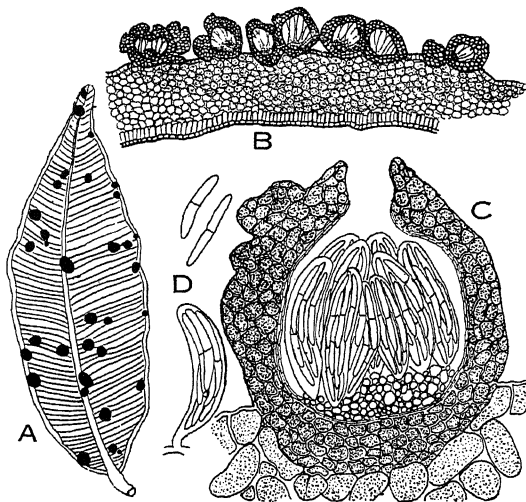


FIG. 1. A, Habit,  $\times$  Natural size; B, Multiloculate stroma (Section),  $\times$  30; C, A single locule,  $\times$  220; D, Ascus and Ascospores,  $\times$  220.

*Rosenscheldiella* is a new genus record for India and *Eugenia heyneana* Duth. a new host for *Rosenscheldiella eugeniae* Petch.

The exicatti are being deposited at the Herb. Crypt. Indiæ Orientales, New-Delhi, India.

The writer wishes to express his thanks to Prof. M. N. Kamat for his guidance, to Dr. E. Muller, for help rendered in identification and to the Director, M.A.C.S., for laboratory facilities. He is also thankful to Dr. J. W. L. Peiris, Plant Pathologist, Peradeniya, Ceylon, for supplying the relevant abstracts from *Annals Bot. Gardens*, Peradeniya.

M.A.C.S., Laboratory, S. ANANTHA NARAYAN.  
Poona-4 (India), May 25, 1962.

## INSECTICIDAL CONTROL OF LOCUSTS BY AERIAL SPRAYING

AERIAL spraying of aldrin (30% E.C.) in kerosene oil medium was successfully carried out with a Beaver aeroplane in January, 1962 against a 10 sq. mile pink locust swarm of *Schistocerca gregaria* Forsk (Orth.: Acrididæ) that invaded Ludhiana and Sangrur districts of the Punjab.

Although aldrin, BHC and other insecticides had been used for aerial spraying against the desert locust for the last many years, no published data were available in regard to their efficacy in the field. The only record available in literature was that made by Pruthi and Bhatia (1954) who noted 74% mortality within 48 hours by the use of a very high dose of 60% aldrin in kerosene applied by means of an aeroplane. When BHC, DNC and aldrin were applied against full-grown locust hoppers with a modified sprayer, the mortality recorded was 7, 30 and 99% respectively (Joyce *et al.*, 1955). It seems doubtful if the dosage of BHC and DNC was equivalent to that of aldrin (40% E.C.) which was used at the rate of 4 oz. per acre. However, it is a known fact that the adults require a higher dosage than that used against hoppers. Moreover, mortality among adults also depends upon the state of their activity. Kennedy *et al.* (1948) demonstrated in the laboratory that BHC when applied on resting individuals of the desert locust gave an LD 50 of 3 mgm./kgm. as compared to 4.5 mgm./kgm. for the flying insects.

Another consideration for aerial spraying is the selection of a suitable insecticide which should be economical and at the same time kill locusts quickly so that the swarm need not have to be sprayed repeatedly. The comparative efficacy of some insecticides was studied in the laboratory by MacCuaig and Yeates (1961), who injected BHC, Dieldrin and Diazinon into adults of *Schistocerca paranensis* and recorded an LD 50 of 3.5, 3.1 and 5.3 respectively.

In the field trials under report aldrin alone was used at the rate of 3, 5, 7 oz. of actual insecticide per gallon of kerosene oil, which was used as a diluent. The spray was applied at the rate of 2 gallons per acre. Since the

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swarm kept encircling in a thickly populated and heavily cropped area only patch spraying was carried out. It was done during the early hours of the morning when swarm was found settled on the tops of trees. When the swarm moved during daytime it was tracked with the help of wireless sets.

After each experimental sortie, three sample lots of 100 locusts each for the doses applied were collected from the topmost portions of trees. The treated and the untreated samples of locusts were kept in cages and the mortality was recorded after every 24 hours. Fresh food was provided to the insects every 8 hours. The mean percentage mortalities and the air temperature at the time of application of the spray are presented in Table I.

The mortalities observed on the 6th day of spraying were converted into angles and analysed statistically. The differences between treatments and the control were significant at the 1% level.

TABLE I  
Percentage mortality caused by different doses of aldrin

Treatments Dose of aldrin (30% E.C.)		Temperature at the time of application (° C.)	Duration after application (days)						
			2	4	6		8	10	12
					%	Angles			
3 oz. per gallon	..	20	63.0	85.0	100.0	84.3	100.0	100.0	100.0
5 "	..	10	14.5	34.1	76.6	61.0	82.0	89.3	100.0
7 "	..	12	6.0	29.0	50.0	45.0	86.0	100.0	100.0
Control	..	..	0.0	0.0	0.3	5.7	0.3	0.3	6.0
					± 12.25				

When sprayed with 3, 5 and 7 oz. of aldrin per gallon complete mortality was observed among the locusts within 6, 12 and 10 days respectively, whereas among the controls there was only 6% mortality in 12 days.

At first it appeared strange that locusts sprayed with 3 oz. should die within 6 days, whereas those sprayed with 5 or 7 oz. should take almost double the period of time. On closer study it was observed that the temperature at the time of application had negative correlation with the duration of time in which there was complete mortality, irrespective of the concentration of insecticide used. When the temperature was around 20° C. the locusts showed movements of their head and legs, whereas at 10 or 12° C. there were only restricted movements. There also was lesser spread of wings at the latter temperatures. It appeared that as a result of more active movements vulnerable areas of the body surface,

particularly the neck and appendicular articulations, became exposed to the spray. The locust which received a greater quantity of spray on such spots died earlier than those which remained comparatively inert at 10 or 12° C.

Since the swarm was followed and sprayed continuously for 7 days till it was eventually destroyed, parts of it must have been hit more than once. There was no way to know that a particular part of the swarm had been sprayed already. There is, therefore, a great need for an insecticide which could give a quick knock-down effect. In the studies under report, BHC could not be tried along with aldrin, but it would have been worthwhile to make the comparison. Some of the recent insecticides, namely DDVP and Dibrom (MacCuaig and Yeates, 1961), which are reported to have the quality of a quick knock-down effect within 2 to 3 hours, seem to be promising insecticides with the desired quality.

Government Agri. College  
and Research Institute,  
Ludhiana, June 16, 1962.

A. S. ARWAL.

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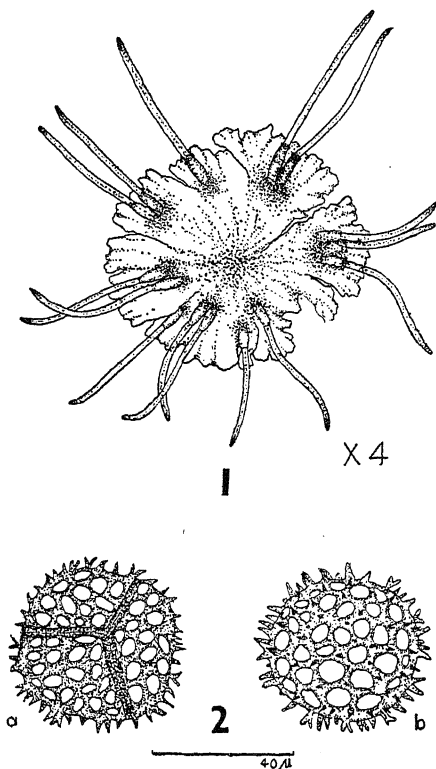
#### OCCURRENCE OF *ANTHOCEROS CRISPULUS* (MONT.) DOUIN IN GORAKHPUR

*Anthoceros crispulus* (Mont.) Douin has been found growing abundantly year after year on the banks of a small rivulet, Turanala, flowing on the east of Ramgarh forest at a distance of seven miles east of Gorakhpur. The plants grow under the shade of *Eugenia heyneana*

Duthie and often in association with *Riccia cruciata* Kashyap and *R. plana* Taylor. An earlier report of *A. crispulus* is by Pande and Ahmad<sup>1</sup> from Lucknow and a detailed morphology of the plant has been worked out by Bhardwaj.<sup>2</sup>

The prostrate rosettes of *A. crispulus* found in Gorakhpur are bright to pale green in colour and grow crowded together or scattered on the swampy soil (pH = 7.3).

The thalli with their lobed or incised margin (Fig. 1) are from 1.5 to 3.0 cm. in diameter and are spongy. The thallus is up to 35 cells thick in the middle and each cell has a single large chloroplast and a nucleus. The mature sporogonia vary between 1.5 and 4.5 cm. (usual size being about 2.5 cm.) and the involucre around their base from 0.3 to 0.35 cm. in length. The spores are dark brown to black in colour and are hispid. The short spines may be simple or bifid to trifid. In size the spores vary between 44 and 52  $\mu$ . Triradiate mark is also distinctly visible (Fig. 2).



FIGS. 1-2. *Anthoceros crispulus* (Mont.) Douin.  
Fig. 1. Thallus. Fig 2. Spore. (a) proximal face,  
(b) distal face

The rare occurrence of this species in the plains is interesting. Its occurrence along the banks of Turanala, which originates from the foothills of Nepal (about 59 miles north of Gorakhpur) may be conceived by the possibility of its spores being brought to the place of origin of the rivulet by small hilly rivers.

The author is indebted to Prof. K. S. Bhargava for facilities and to Dr. D. C. Bhardwaj of Birbal Sahni Institute of Palaeobotany, Lucknow, for confirming the identification of the species.

Department of Botany,  
University of Gorakhpur,  
Gorakhpur, August 25, 1962.

R. SAHAI.

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#### TETRAPLOIDY IN *RAUVOLFIA* *SERPENTINA* BENTH.

*Rauvolfia serpentina*, the Sarpagandha of Ayurveda, long known for its sedative properties has risen to great importance in recent years because of its efficacy in the treatment of hypertension.

The plant occurs in the wild state in India in the Siwaliks and Sub-Himalayan tracts and along the Gangetic plain, in Bihar, Bengal and Assam as well as in parts of Central India, and all along the Western Ghats. Outside India, it is reported from the Andamans, Ceylon, Burmah, Thai, Malaya and Java. All the wild varieties so far examined are found to be diploids  $2n = 22$  and these include those collected by me from Rishikesh, Kerala, Bengal and Dehra Dun as well as those reported from Thai, Pakistan and Darjeeling by Kawatani.<sup>1</sup> With the increased demand for the drug, cultivation of *R. serpentina* is being organized on a large scale in many States. Variation in alkaloid content has been noted by Bal<sup>2</sup> in different geographical races and in general North Indian forms had higher alkaloid contents than those from South India.

Tetraploidy was induced in *Rauvolfia serpentina* by treatment of seeds, seedlings and stem cuttings with colchicine. These tetraploid plants had  $2n = 44$  chromosomes. They had broader and thicker leaves and larger flowers than the diploids (Figs. 1 and 2). Occasional tetraploid shoots were also found arising spontaneously from callus tissue on wounded roots of diploid plants in cultivation.



FIG. 1. *Rauwolfia serpentina* (DIPLOID)



FIG. 2. *Rauwolfia serpentina* (TETRAPLOID)

While 2-year old diploid *Rauwolfia serpentina* plants had 1.54% total alkaloids, preliminary chemical examination of a 2-year old tetraploid plant gave 2.28% total alkaloids.

Further studies on tetraploid *Rauwolfia serpentina* are in progress.

Regional Research Laboratory,  
Assam, September 4, 1962.  
E. K. JANAKI AMMAL.\*

\* At present working at the Regional Research Laboratory, Jammu.

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#### A NEW AECIAL HOST OF *PUCCINIA ARISTIDAE* TRACY

The fungus was recorded from India (Delhi) by Chona *et al.*<sup>2</sup> They noted the telial stage on the grass *Aristida adscensionis*. According to Arthur,<sup>1</sup> *Puccinia aristidæ* has about a hundred aëcial hosts spread out in 24 families including the Amaranthaceæ, Cappariaceæ, Cruciferae, Chenopodiaceæ and Solanaceæ. He remarked that probably no other

species possesses such a large number of distantly related aëcial hosts. However, in India, no aëcial host seems to have been discovered for this rust. Recently Prasad *et al.*<sup>4</sup> recorded *Aecidium pupaliæ* spec. nov. on *Pupalia lappacea* from Udaipur in Rajasthan. The present communication shows the biological relationship between *Puccinia aristidæ* and *Aecidium pupaliæ*.

The leaves of both the hosts were floated in petri dishes containing 10% sucrose solution. Fresh aëciospores were dusted on the leaves of *Aristida*. The uredia developed within about four days. The aëciospores dusted on the potted plants also produced infection in the same time. The teliospores could be germinated nearly three months after their collection. The hanging drop technique was employed. They gave rise to a promycelium in two days. The germinated teliospores were transferred to the leaves of *Pupalia*. The pycnia developed within ten days and a few aëcia appeared in four or five days but only when newly unfolded leaves were floated in petri dishes. The germinating teliospores were fixed in acetic-alcohol (acetic acid, 1 ml.; absolute alcohol, 3 ml.) and stained with acetocarmine.

During July, 1961, well-formed aecial cups of *Aecidium pupaliae* were observed on plants of *Pupalia lappacea* (Amaranthaceae) growing at Delhi Ridge. Well-formed uredial and telial sori were obtained upon inoculating the aeciospores on the leaves of *Aristida adscensionis*. The characters of the rust agreed with those of *Puccinia aristidae*. The inoculation of the leaves of *Pupalia lappacea* with the germinated teliospores gave rise to well-developed pycnia and aecia whose characters in turn resembled those of *Aecidium pupaliae*. The two hosts (*Aristida adscensionis* and *Pupalia lappacea*) occur in close association on the Delhi Ridge. *Pupalia lappacea*, therefore, appears to be a new aecial host for *Puccinia aristidae*.<sup>5</sup>

Pycnia begin to develop in the third week of July and aecia can be found by the end of the month. Aecial cups continue to be formed up to the end of August. Sparse uredial infections are found in the beginning of August and by September this stage becomes very common. The teliospores are found from the end of October to December. They remain dormant through the winter, spring and summer months and germinate in July with the onset of the rains.

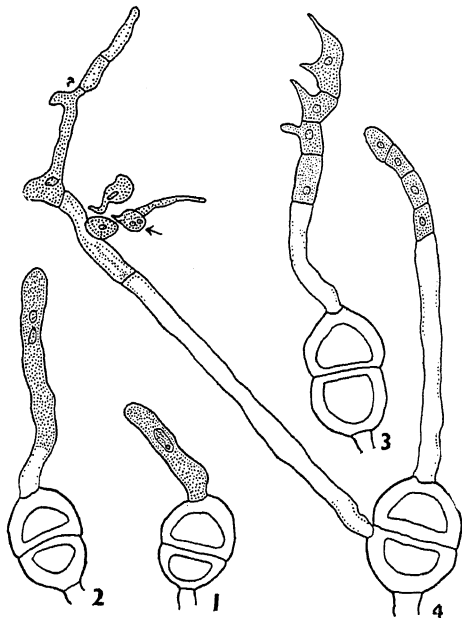
The pycnia and aecia occur on the leaves only. The former are amphigenous (cf. Prasad *et al.*<sup>4</sup>), orange in colour and bear ostiolar periphyses. The aecia are hypophyllous and peridiate. The uredia and telia occur on leaves, leaf sheaths and stems. The uredia are small, oval-shaped, brown and frequently coalescent. The telia are black and much elongated. The characters of uredia and telia resemble those given by Cummins.<sup>3</sup> As the teliospore germinates, the cytoplasm aggregates in the upper region of the promycelium and the nucleus migrates into it (Figs. 1 and 2). The four transverse walls, which appear after meiosis, are laid down in the upper region of the basidium only (Figs. 3 and 4). The promycelium was generally found to be quite long (probably due to the excessive moisture available to the teliospores in hanging drop cultures). The sterigmata are also long. The sporidia frequently germinate *in situ* and commonly show two nuclei (Fig. 4).

Thus, *Puccinia aristidae* Tracy (on *Aristida adscensionis*) = *Aecidium pupaliae* Prasad *et al.* (on *Pupalia lappacea*). *Amaranthus* sp., another member of the Amaranthaceae, is also known to be the aecial host of this rust (Arthur<sup>1</sup>).

I am grateful to Prof. P. Maheshwari for interest and encouragement.

Department of Botany,  
University of Delhi,  
Delhi-6, August 1, 1962.

HARDEV SINGH.



FIGS. 1-4. Fig. 1. Newly germinated teliospore,  $\times 416$ ; Figs. 2-3. Stages in the germination of teliospores,  $\times 416$ ; Fig. 4. Germinated teliospore; one of the sporidia marked with an arrow shows two nuclei and *in situ* germination,  $\times 416$ .

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#### THE GAMETOPHYTE OF *CONIOGRAMME FRAXINEA*

*Coniogramme fraxinea* (Don) Dick. is the Indian representative of a large genus of tropical terrestrial ferns, usually listed by taxonomists among the Gymnogrammeoid ferns. In common with most genera of the Gymnogrammeoideae, the morphology of *Coniogramme* is little understood and its phylogeny is still a matter of dispute among contemporary pteridologists.<sup>1-3,5</sup> The present study deals with the morphology of the spores, prothalli and juvenile sporophytes of *C. fraxinea*. Spores are collected from Shillong

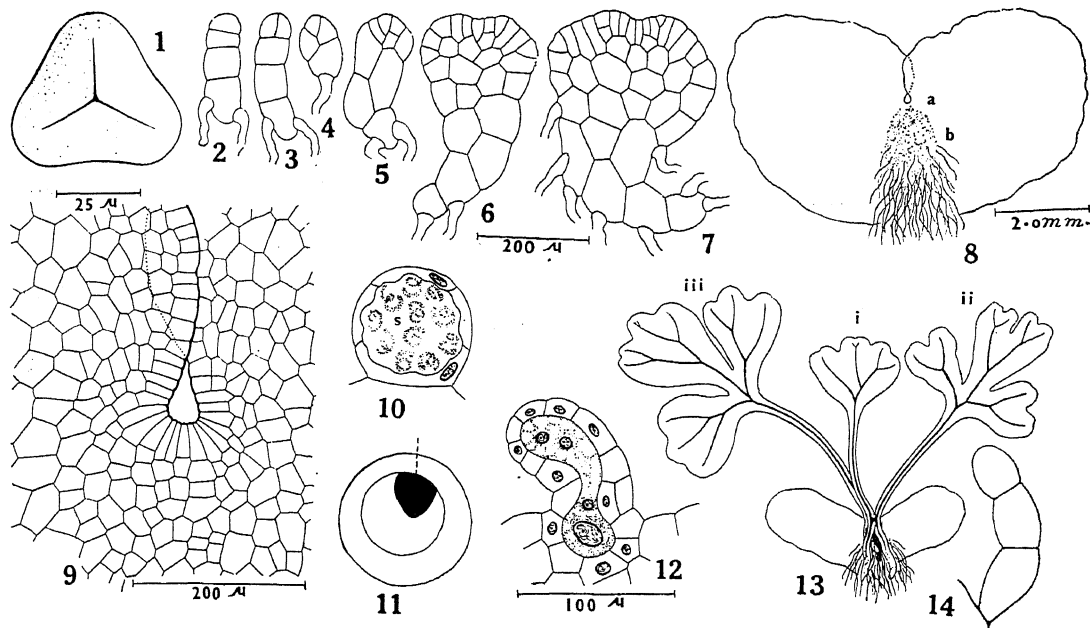


Peak (1,500 m.), Assam, and cultured on nutrient agar media<sup>8</sup> maintained at a light intensity of 600 ft-c and a temperature of  $24 \pm 2^\circ \text{C}$ . Spore morphology is based on acetolysed preparations.<sup>4</sup>

The spores of *C. fraxinea* are trilete, with a triangular amb having smoothly rounded corners and concave sides (Fig. 1), with faintly granulate exine, and  $30 \times 46 \mu$  (P  $\times$  E) on an average. They are anisopolar, with a flattened proximal half, and a long crassimarginate l  sura. On spore germination, a 2-4 cells long germ filament, composed of short barrel-shaped cells (Fig. 2) is formed. An obconical apical meristematic cell is then differentiated in the terminal cell in the usual way and by the activity of this cell the prothallus becomes spatulate in shape within two weeks of spore germination (Figs. 3-6). The anterior region of the prothallus expands rapidly and the meristematic cell becomes lodged in a shallow median notch which gradually becomes deeper as growth continues. The apical meristematic cell is replaced by a multicellular meristem, either as soon as the apex of the prothallus becomes cordate (Fig. 7)

midrib is initiated when the thalli are about a month old.

In about 4 months after spore germination, the prothalli attain maturity. The mature thalli are characteristic in being usually broader than long and often obreniform in shape. In most cases the apical notch is broad, but some thalli (often when they are nearly 5 months old) may possess a narrow apical notch, sometimes even having overlapping sides (Fig. 8). The apical meristem is broad and composed of a large number of narrow columnar cells (Fig. 9). The wing cells are thin-walled with very slight collenchymatous thickenings of the corners. The midrib is narrow and composed of 4-6 layers of small cells. The prothalli are naked as in the other *Gymnogrammeoide  *.<sup>6,7,9</sup> The antheridia are large, globose, and having the usual type of structure in the advanced ferns (Fig. 10). The basal cell is short and often saucer-shaped. The opercular cell is single and opens by a small pore (Fig. 11, o), which gradually expands to release the sperms. The archegonia are of the usual type (Fig. 12) and the neck is long, curved prominently away



FIGS. 1-14. Fig. 1. Proximal view of the spore. Figs. 2-7. Stages in the development of the prothallus. Fig. 8. Mature prothallus. Fig. 9. Apical region of the same. Fig. 10. L.s. of mature antheridium. Fig. 11. Dorsal view of mature antheridium showing pore-like opening in the opercular cell. Fig. 12. L.s. of archegonium. Fig. 13. Juvenile sporophyte attached to prothallus. Fig. 14. Hair on the lamina of the first juvenile leaf. (a, archegonia; b, antheridia; o, opening in opercular cell; s, sperms; i, ii, iii, the 1st, 2nd and 3rd juvenile leaves.)

or, more commonly, a little later. Growth of the prothallus is rapid and the formation of a

from the apex of the prothallus and often becoming parallel to the prothallial surface.

The first juvenile leaf of the sporophyte is generally broadly cuneate, with the outer margin shallowly lobed into 3 or 4 flatly rounded lobes. The single vascular bundle entering the lamina is forked equally at the base and one of the branches gives off a medianly placed midrib (Fig. 13, i). The second leaf (in some cases the very first one itself) possesses a broadly ovate, deeply trilobed lamina, with a prominent midrib bearing alternating lateral veins (Fig. 13, ii). In the succeeding juvenile leaves there is a pronounced elongation of the apex, followed by formation of successive pairs of lateral lobes. The adult condition is attained by increase in the number of the lateral lobes and the development of midribs in them followed by the characteristic fusions of the lateral veinlets of the midrib. Superficial multicellular hairs (Fig. 14) occur over the vein tips and the stipe bases of all the early juvenile leaves. In later formed leaves, the hairs spread all over the veins.

The author is grateful to Prof. K. N. Kaul, Director, for his keen interest in this work.

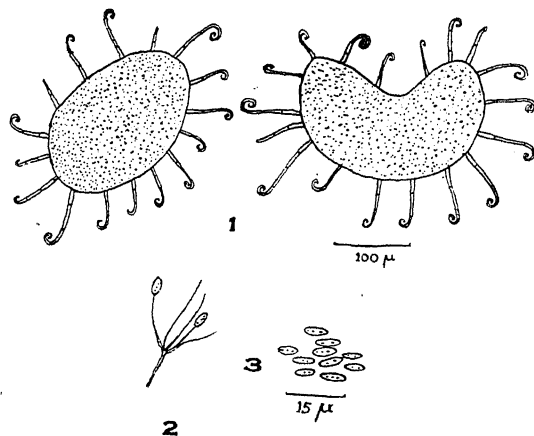
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#### REPORT OF A NEW FUNGUS FROM SOIL

THE present fungus was isolated from soil during the course of investigation on soil-fungal flora of Varanasi. It first appeared on peptonedextrose agar medium and was later transferred to oat-meal agar medium for detailed study. The important characters of the fungus are the formation of floccose aerial hyphae, superficial setose pycnidia and branched conidiophores bearing spore inside the pycnidium. The tips of the setae are coiled in a circinate manner. The fungus bears pycnidia with spores inside and hence will be classified in the order Sphaeropsidales and since no genus with this sort of setose character of the pycnidium is described so far in this group, a new genus is

being proposed to accommodate it. The characters of the fungus are as given below:



FIGS. 1-3. Fig. 1. Showing setose-pycnidia. Fig. 2. Showing branched conidiophore. Fig. 3. Showing pycnidiospores.

Colonies on oat-meal agar medium growing moderately at 32° C. bearing aerial floccose hyphae, at first hyaline becoming brownish due to the formation of pycnidial bodies, colour being deep-brown at maturity (Horsechestnut, Maerz and Paul colour, Pl. 8 J, 5\*), reverse dirty brown (Seal Pl. 8 E, 10), hyphae hyaline with greenish tinge, varying from 2-5  $\mu$  in diameter, sometimes aggregated together forming ropes, pycnidia superficial formed in abundance after three days of the inoculation, at first light-brown becoming Horsechestnut brown at maturity (Pl. 8 J, 5), varying in shape from globose, sub-globose, elongated, angular to bean-shaped, measuring from 140-395.5  $\times$  129.5-308.0  $\mu$ , setae septate, brown in colour, straight or curved, coiled at the tips, coiling generally once, sometimes twice in circinate manner, varying from 28-133  $\times$  3.5-7  $\mu$ , pycnidiospores formed on the branched conidiophores inside the pycnidium and extruded out *en masse* by irregular rupturing of the pycnidium, spores aseptate, sub-globose, hyaline with greenish tinge and vary from 4.5-7.5  $\times$  2-3  $\mu$ .

The author expresses his grateful thanks to Dr. R. Y. Roy, for valuable guidance and encouragement, and to Prof. R. Misra, for providing laboratory facilities.

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Banaras Hindu University,  
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May 15, 1962.

\* Maerz and Paul, *Dictionary of Colour*, 1930.

## REVIEWS

Royal Society Mathematical Tables. VII. Bessel Functions. (*Part III.—Zeros and Associated Values.*) Edited by F. W. J. Oliver. (Published for the Royal Society at the University Press, Cambridge), 1960. Pp. x + 79. Price 50 sh. net.

Bessel functions find such wide application in physics, engineering and mathematics that there is no need to point out the importance and value of tables containing the values of the cylindrical functions and their zeros. In the present volume, there are three tables: Table I gives the zeros  $j_{n,s}$  of  $J_n(x)$ ,  $y_{n,s}$  of  $Y_n(x)$  and the values of  $J'_n(j_{n,s})$ ,  $Y'_n(y_{n,s})$ . Table II gives zeros  $j'_{n,s}$  of  $J'_n(x)$ ,  $y'_{n,s}$  of  $Y'_n(x)$  and the values of  $J''_n(j'_{n,s})$ ,  $Y''_n(y'_{n,s})$ . Table III gives zeros  $a'_{m,s}$ ,  $b'_{m,s}$  of the derivatives  $j'_m(x)$ ,  $y'_m(x)$  of the spherical Bessel functions

$$j_m(x) = \sqrt{\frac{\pi}{2x}} J_{m+\frac{1}{2}}(x),$$

$$y_m(x) = \sqrt{\frac{\pi}{2x}} Y_{m+\frac{1}{2}}(x)$$

and also the values of  $j_m(a'_{m,s})$ ,  $y_m(b'_{m,s})$ . The ranges covered are

$n = 0(\frac{1}{2})20\frac{1}{2}$ ;  $s = 1(1)50$  (Tables I and II)  
 $m = 0(1)(20)$ ;  $s = 1(1)50$  (Table III).

This introduction gives a good account of the important properties of the Bessel functions, their zeros, and the numerical methods of computing them.

K. S. VISWANATHAN.

Interfacial Phenomena. By J. T. Davies and E. K. Rideal. (Academic Press, New York and London, Asia Publishing House), 1961. Pp. xiii + 474. Price \$ 14.00.

Developments in surface chemistry on the theoretical side, and more so, on its practical applications in industry and engineering, and in such important problems as the conservation of storage water in lakes and reservoirs, have been significant and rapid during the last two decades. Literature on the subject is growing, large and scattered. There is a need for a connected account of the latest researches, especially on the theoretical aspects of the subject, which will be of help to investigators in this discipline. The present volume by two well-known workers in the field will meet this need.

Sir Eric Rideal is well known for his outstanding contributions, spread over a period of nearly forty years, on surface phenomena, interfacial tensions, and the physics and chemistry of monolayers. Latterly Professor Davies joined Sir Eric in these investigations, and the present volume is, in the main, a systematic presentation of the results of their joint studies during the last ten years in this field of research. The book is without doubt authoritative and the treatment in the majority of chapters, like their contents, is original, and therefore highly instructive.

In the first chapter on the Physics of Surfaces, fundamental ideas about surface tension, surface energy, kinetics of spreading, and contact angles are clearly explained. The principles underlying their experimental determinations are given. The second and third chapters deal, in a largely original way, with the electrostatic and electrokinetic phenomena occurring in surfaces and interfaces. The fourth chapter deals with the thermodynamics of adsorption and desorption, and with Gibbs's equation. The fifth chapter treats with the properties of monolayers, and the sixth chapter with reactions in monolayers and emulsions. Chapter seven is on Diffusion through interfaces, and discusses, among other things, barriers impressed by monolayers to the passage of vapour and solvents across phase boundaries, and resistance to evaporation and its reduction. In the last chapter is discussed the characteristics of disperse systems and of adhesion, especially in so far as these follow from the fundamental interfacial properties described in the earlier chapters.

As the only book now available which gives a systematic and original account of the latest developments in interfacial phenomena, the book is warmly recommended not only to chemists and chemical engineers but also to biologists who will find in it many stimulating ideas.

A. S. G.

Low Temperature Physics. By L. C. Jackson. (Methuen's Monographs on Physical Subjects.) Methuen and Co. Ltd., London, 1962. Pp. vii + 158. Price 18 sh.

Since the first publication in 1934 of this well-known Methuen Monograph on Low

*Temperature Physics* it had gone through four editions, each edition being revised and the subject-matter brought up-to-date. The fourth edition of the book was published in 1955. Since then there has been much progress in low temperature investigations of physical and electrical properties of substances, and results of fundamental significance to our knowledge of the subject have been achieved. Taking all these into account the author has completely revised and rewritten this monograph and the new fifth edition should prove as successful as the previous ones.

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**Laboratory Instruments—Their Design and Application.** (2nd Edition). By A. Elliott and J. H. Dickson. (Chapman and Hall, 37, Essex St., London W.C. 2; India: Asia Publishing House, Bombay), 1959. Pp. xvi + 514. Price 55 sh.

Successful research workers as well as persons who have anything to do with laboratory work and maintenance of apparatus should have some fundamental knowledge of instrument design and workshop practice. It often becomes necessary for a research student to design and construct some simple instruments of his own to suit his special needs of research. A guide book for the purpose is essential. *Laboratory Instruments* which has been written on the basis of accumulated experience gained during many years of research work by the authors can be recommended as an ideal book to meet the purpose, at least so far as mechanical and optical matters are concerned.

The first edition of the book which was published in 1951 was well received. The demand for a second edition has enabled the authors to revise and add new materials so as to bring the book up-to-date. The chapter on properties of materials has been expanded to include corrosion-resistant metals and a fuller account of plastic materials. "Natural and synthetic optical crystals" is again a new chapter giving latest available information on the refractive index of materials useful in infra-red spectroscopy. Photometry, colour vision, and photography are other sections in which substantial new matter has been added. Again, there is a new chapter on a subject of practical importance, namely, corrosion in laboratory instruments.

A. S. G.

**Scientific Foundations of Vacuum Technique.** (Second Edition.) By Saul Dushman. (John Wiley and Sons, Inc., New York 16, N.Y.), 1962. Pp. xviii + 806. Price \$ 19.50.

Dushman's book on vacuum technology is a classic on the subject and it contains the results of the author's lifetime study of every aspect of high vacuum technique, both in theory and in practice, at the General Electric Research Laboratory. The book enjoyed great popularity amongst students and research workers since its first publication in 1949. For some time past the book has been out of print even though the demand continued to persist. Hence the appearance of this second edition of the book will be widely welcomed.

Like many other branches of science, vacuum technology also has made rapid strides during the last decade both in research and in industry. Ultra high vacuum techniques have already had a profound influence on work in surface physics, surface chemistry and gaseous electronics. These techniques are sure to play a big role in various disciplines of modern research in the immediate future. It may be said that from the point of view of an inquiring research worker on high vacua there is at present no other treatise on the subject which is as comprehensive as the one now under review. It contains not only practical information on the technology but also the fundamentals of background information necessary for a sound understanding of the applicability of modern techniques and future advances on the production, measurement, maintenance and utilization of vacua.

The task of re-editing this work to satisfy the present developments in the subject has been undertaken by J. M. Lafferty with the close co-operation of a selected number of specialists of the General Electric Research Laboratory, where Dushman himself worked. The original plan of the book and the division into chapters as given below have been maintained, but each topic has been thoroughly revised bringing the contents and references more up-to-date.

The chapter headings are: (1) Kinetic Theory of Gases, (2) Flow of Gases through Tubes and Orifices, (3) Vacuum Pumps, (4) The Utilization of Pumps, (5) Manometers for Low Gas Pressures, (6) Sorption of Gases and Vapours by Solids, (7) Sorption of Gases by "Active" Charcoal, Silicates (including Glasses), and Cellulose, (8) Gases and Metals, (9) Chemical and Electrical Clean-up and Ultrahigh Vacuum, (10) Vapour Pressures and Rates of Evapora-

tion, (11) Dissociation Pressures of Oxides, Hydrides and Nitrides.

A. S. G.

**Barley and Malt—Biology, Biochemistry, Technology.** Edited by A. H. Cook. (Academic Press, New York and London), 1962. Pp. xiv + 740. Price £ 7/10 sh.

The volume under review deals with the biological, biochemical and technological aspects of barley and barley malt. Malt is the basic raw material for the brewing industry and also for the preparation of malt extract. A large volume of research work has been carried out during recent years in several countries on the, biochemistry and technology of malting of barley and other grains. The book is the result of contributions by several leading authorities on the different aspects. The volume presents, for the first time, a unified account of the diverse aspects of the subject of barley and malt.

The first five chapters deal with the barley plant, first in general terms and later with respect to scientific aspects of breeding new barley varieties suitable for malting, including a consideration of diseases of barley. The next three chapters are concerned with the subject of malting under the heads, evaluation of malting process. The concluding three chapters summarise available information on the chemical analysis and chemistry of barley and malt and the enzymic changes during the malting process. Every effort has been made by the authors to incorporate recent developments in the field and to make the book authoritative and up-to-date. The book will serve as a reference work not only to research workers in the field but also to others interested in the subject of malting. The get-up of the book is excellent.

M. SWAMINATHAN.

**A Laboratory Manual—Ionization Constants of Acids and Bases.** By A. Albert and E. P. Serjeant. (Methuen and Co., Ltd., London), 1962. Pp. xii + 179. Price 21 sh.

This is a carefully written laboratory manual on the practical determination of the ionization constants of acids and bases. The determination of the ionization constants has important theoretical and practical uses. For one thing, it helps to find out the proportions of the different ionic species into which a substance is divided at any chosen pH. This kind of

information is of significant help in spectrophotometric work. Ionization constants are closely related to solubility. Again the structure of newly found substances can often be inferred from the ionization constants.

After a brief theoretical introductory chapter dealing with the outlines of the chemistry of ionization, the manual proceeds to describe, with all necessary details, in four separate chapters the various methods of determining the ionization methods, then the spectrometric methods, and finally the conductimetric methods. In each method detailed instructions are given about the use of the apparatus, preparation of solutions, carrying out of the experiments, calculation of results illustrated by some simple worked examples, precautions to be taken, common difficulties that may be encountered and how these can be overcome, etc.

There is a chapter on solubility-ionization relationships, one on Zwitterions (Dipolar ions), and one on stability constants of metal complexes. Ionization constants of some 400 typical acids and bases are given in the form of appropriate tables with suitable commentaries.

**Electron Microscopy—A Handbook for Biologists.** By E. H. Mercer and M. S. C. Birbeck. (Blackwell Scientific Publications, Oxford), 1961.

This is a handy booklet detailing "well-tried recipes" for electron microscopy of biological material. Since at a rough estimate the resolution obtained with an electron microscope is said to be only one-tenth the thickness of the object, the need for ultra-thin sections would become obvious. For contrast, the use of specific fixatives and "stains" is necessary.

Detailed instructions are given on handling of material but a beginner is advised "to spend a short time with an experienced electron microscopist".

The book would be of great value to biologists.

M. K. SUBRAMANIAM.

**Methods in Hormone Research.** Edited by Ralph I. Dirfman. Vol. I: *Chemical Determination*. Vol. II: *Bioassay*. (Academic Press, New York and London; India: Asia Publishing House, Bombay-1), 1962. Pp. xiii + 423. Price \$ 16.00; Pp. xv + 774. Price \$ 24.00.

Developments in methodology are the essential forerunners of progress in any scientific field. The rapid advances in instrumentation and the introduction of refined techniques in the allied

branches of biochemistry, physiology and organic chemistry have given to the endocrinologists elegant tools capable of resolving many problems associated with hormonal disturbances which, because, of the microquantities involved, had hitherto resisted all attempts of analysis.

Information resulting from the application of these techniques for hormonal research found scattered in the various journals has now been brought within the framework of these two comprehensive volumes.

The critical analysis of the various methods besides the general survey provide authoritative reviews, most welcome to analytical chemists, pharmacologists engaged in bioassay of hormones and to physicians planning clinical research programmes.

Volume I deals with the 'chemical and physical methods' of determination of the following hormones: Estrogens, 17 ketosteroids and Testosterone, progesterone, pregnane-diol, pregnanetriol, pregnanetriolone—an abnormal urinary steroid, Adrenocorticosteroids, Aldosterone and metabolites, Adrenaline and noradrenaline and the chemical assay of thyroxine-like materials. The reviews provide a biochemical background of their metabolism, principles involved in assay procedure and detail the newer physico-chemical procedures for isolation of small amounts of these hormones from biological fluids.

Volume II is complementary to the first volume in its coverage. Bioassay is still essential and in many cases the only method available for determining the hormonal activity of some biological materials.

Biological standardization needs clear grasp of statistical analysis. Statistical methods used in biological experimentation are lucidly presented in the introductory chapter of this volume.

The methods of bioassay for steroidal and protein hormones are exhaustively dealt with and a separate chapter mentions the standard methods adopted by official organizations for such bioassays.

"Antihormonal substances" discussed in some chapters also visualise new approaches for the chemotherapy of clinical disorders associated with hyperhormonal secretions.

M. SIRSI.

#### Books Received

*Natural History of Infectious Disease* (3rd Edn.).

By M. Burnet. (Cambridge University Press, London N.W. 1), 1962. Pp. x + 377. Price 30 sh.

*The Wealth of India—Raw Materials* (Vol. IV).—*Fish and Fisheries*. (Council of Scientific and Industrial Research, New Delhi), 1962. Pp. xv + 132. Supplement to Vol. IV.

*Science Puzzlers*. By Martin Gardner. (Macmillan and Co., London W.C. 2), 1962. Pp. 123. Price 10 sh. 6 d.

*The Diagnosis of Mineral Deficiencies in Plants by Visual Symptoms* (3rd Edition). By T. Wallace. (Her Majesty's Stationery Office, London W. 1), 1961. Pp. vii + 125. Price 63 sh.

*Plant Embryology—A Symposium*. (C.S.I.R., Rafi Marg, New Delhi-1), 1962. Pp. vi + 273. Price Rs. 20-00.

*Seasonal Flowers*. By B. L. Desai. (I.C.A.R., Queen Victoria Road, New Delhi), 1962. Pp. x + 177. Price Rs. 11-00.

*Water Plants*. By B. B. Singh Bhadri and B. L. Desai. (I.C.A.R., Queen Victoria Road, New Delhi), 1962. Pp. x + 44. Price Rs. 3-75.

*Fish in Nutrition*. Edited by E. Heen, and R. Kreuzer. [Fishing News (Books Ltd.), Ludgate House, London E.C. 4], 1962. Pp. xxiii + 447. Price £ 6 6 d.

*Diseases of Sorghum Sudan Grass and Broom Corn*. By S. A. J. Tarr. (Commonwealth Mycological Institute, Ferry Lane, Kew, Surrey), 1962. Pp. x + 380. Price 80 sh.

*The Life-Story of the Fish*. By Brian Curtis. (Dover Publications, Inc., New York 14, N.Y.), 1961. Pp. xii + 284. Price \$ 1.50.

*Hydraulics*. By N. S. Govinda Rao. (Asia Publishing House, Bombay-1), 1962. Pp. xvi + 412. Price Rs. 22-00.

*Study Guide for the Mainstream of Physics*. By A. D. Beiser. (Addison-Wesley Pub. Co., Reading, Mass., U.S.A.), 1962. Pp. viii + 166. Price \$ 2.50.

*Proceedings of the International School of Physics. 'Enrico Fermi' Course XVII: Topics on Radiofrequency Spectroscopy*. Edited by A. Gozzini. (Academic Press, 111, Fifth Avenue, New York 3, N.Y.), 1962. Pp. viii + 312. Price \$ 10.00.

*Text-Book on Spherical Astronomy* (5th Edn.). By W. M. Smart. (Cambridge University Press, London N.W. 1), 1962. Pp. xii + 430. Price 22 sh. 6 d.

*Self-Smoothing Fabrics*. By J. T. Marsh. (Chapman and Hall, London W.C. 2), 1962. Pp. vi + 399. Price 70 sh.

*Artificial Earth Satellites* (Vols. 9 and 10). (Consultants Bureau Enterprises, Inc., 227 W, 17 St., New York 11, N.Y.), 1962. Pp. 239. Price \$ 30.00 (\$ 15.00 per vol.).

## SCIENCE NOTES AND NEWS

### Award of Research Degrees

Annamalai University has awarded the Ph.D. Degree in Chemistry to Shri A. Ekambaram for his thesis entitled "Dipole Moments and Absorption Spectra of Some Sulphoxides".

Osmania University has awarded the Ph.D. Degree in Chemistry to Shri Venkatachala Somayajulu Vangala for his thesis entitled "Search for Physiologically Active Compounds: Synthesis of Some Condensed Oxazoles".

### The 20th Anniversary of the World's First Nuclear Reactor

Leading atomic scientists from several countries have contributed to a Special Number of the *International Atomic Energy Agency Bulletin* to mark the 20th Anniversary of the start-up of the World's First Nuclear Reactor.

The reactor, built in the grounds of Chicago University by a team of scientists under the leadership of Enrico Fermi, went critical on 2 December 1942. After twenty years, there are today more than 50 nuclear power reactors and some 300 research reactors operating or nearing completion in various parts of the world.

The purpose of the Special Number of the *IAEA Bulletin* is to draw attention to the significance of the construction and successful operation of the first atomic "Pile" in the context of the scientific research and experiments that preceded that achievement and the growth of nuclear science and technology that has followed since. Among those who have contributed to this volume are some of the scientists who laid the foundations of nuclear science or have played leading roles in the development of atomic energy applications in their respective countries.

Thus we find in this *Bulletin* specially written articles by Otto Hahn, Samuel K. Allison, Glenn T. Seaborg, Sir John Cockcroft, Dr. Goldschmidt and V. S. Emelyanov.

A popular descriptive account of the first pile, written originally in 1946 by Aliardice and Trapnell, has also been reproduced in the *Bulletin*. A short introductory article has been written by Dr. Sigvard Eklund, Director-General of IAEA.

The Special Number of the *Bulletin* is published in five languages: English, French, German, Russian and Spanish.

### Effect of Ultra-High Vacuum on Micro-organisms

The effects created by exposing organisms to a vacuum have long been a subject of interest to biologists. The use of vacuum in storing micro-organisms is an essential part of lyophilization preservation technique. In this method, the organisms are frozen at  $-80^{\circ}\text{C}$ . and dehydrated by a vacuum of  $10^{-3}$  mm. mercury. The tubes containing the organisms are sealed off under vacuum and may be stored for several years.

Conflicting views have been expressed regarding the ability of micro-organisms to withstand ultra-high vacuums of the order of  $10^{-8}$  mm. mercury or better. Thus Willard *et al.* reported that exposure of micro-organism spores (*Bacillus subtilis*, *Aspergillus niger*, *A. terreus*, and *Penicillium citrium*) to pressures of  $1.2 \times 10^{-8}$  mm. mercury for periods of time 10 to 30 days would cause their destruction. On the other hand, the work of Porter *et al.* failed to show any effects of vacuum on three types of micro-organisms (*B. subtilis*, *A. fumigatus* and *Mycobacterium smegmatis*) exposed to a vacuum of less than  $10^{-9}$  mm. mercury for 5 days.

To clinch the issue, Morelli *et al.* report their detailed investigations on the effect of ultra-high vacuum on *Bacillus subtilis* var. *niger*. Their results demonstrate that the micro-organism *B. subtilis* will survive exposure to an ultra-high vacuum ( $10^{-8}$  mm. mercury) for a period of 35 days. The experiment also shows that ultrasonic vibrations and radiation encountered during seal-off of the apparatus have no significant effect. It will be interesting to study the effect when *B. subtilis* is exposed to a vacuum approaching that encountered in outer space.—(*Nature*, 1962, 196, 106.)

### Carotenoids in *Delonix regia* (Gul Mohr) Flower

The distribution of carotenoids in petals and anthers of different flowers has been studied and reported by many investigators. But qualitative and quantitative data on the distribution of carotenoids in different parts of the same flower are not so easily available. H. R. Cama and F. B. Jungalwala in an article contributed to the *Biochemical Journal* (1962, 85, 1) report the results of a detailed study of

carotenoids in different parts of *Delomix regia* flower.

The petals of *D. regia* contain 29 carotenoids. The major pigments identified are: phytoene, phytofluene,  $\beta$ -carotene,  $\gamma$ -carotene, lycopene isomers, rubixanthin, lutein, zeaxanthin, and several epoxy carotenoids. The role of epoxy carotenoids in petals is not known. However, they may be intermediates in the transfer of oxygen and formation of xanthophylls.

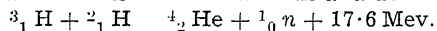
The sepals contain 18 carotenoids, the filaments 20 carotenoids, and the anthers 10.

Certain carotenoids are present only in a particular part of *D. regia* flower, e.g., pigment X,  $\delta$ -carotene and rubixanthin are only found in petals, whereas  $\alpha$ -carotene is confined to sepals.

The highest concentrations of total carotenoids are found in the anthers. Of the total carotenoids here, 90% is zeaxanthin. The presence of considerable amounts of specific carotenoids in the anthers of *D. regia* suggests that 'oxygenated' carotenoids may have some role in the reproduction of this plant.—(*Biochem. J.*, 1962, 85, 1.)

#### A Simple Neutron Source

O. Reifenschweiler and K. Nienhuis of the Philips Laboratories, Eindhoven, describe a neutron source tube which is about the size of an X-ray tube, and is operated in a similar way. Supplied with a direct voltage of 125 kV, this tube is capable of generating neutrons with an energy of 14 MeV. at rates exceeding  $10^8$  neutrons/sec. The neutrons arise out of a nuclear reaction between tritium and deuterium:



The deuterons are produced in a Penning ion source and accelerated up to 125 kV in a single-stage accelerating system. They strike a target consisting of a 1  $\mu$ m film of titanium which has been evaporated on to a silver base, and which contains tritium. The tube is filled with a deuterium-tritium mixture at a pressure of about  $10^{-3}$  torr; consequently the target is bombarded with tritium ions as well as deuterium ions and in this way its charge of tritium is kept at saturation more or less indefinitely. The pressure inside the tube is adjusted by means of a built-in replenisher containing a large reserve of D-T mixture. The life of the tube has been tested to exceed 1000 hours. The yield of the tube can attain  $10^9$  neutrons/sec. when it is pulse-operated (minimum duration 5  $\mu$ s). The article also indicates some typical applications of this compact neutron source.—[*Philips Technical Review*, 1961-62, 23 (11).]

#### Mariner II—the Venus Probe

The US spacecraft, Mariner II, was launched on August 27, 1962 in the direction of Venus, to make closest approach to the planet (but not land on it), and send back data about the planet's atmosphere, etc. The weight of the spacecraft was 447 lb., and it carried in its payload electronic instruments for six scientific experiments. Four of these began operating on the fourth day of the launch and sent back space data on solar wind, magnetic fields, cosmic rays and ionization. The other two "sensors"—microwave and infra-red radiometers—were scheduled to operate on December 14, 1962 when Mariner II passed closest to Venus.

This was achieved when on December 14, radio contact was again made with Mariner II and coded reports were received for 42 minutes, about both the light and dark sides of Venus. Mariner II was then 36 million miles from the earth but had travelled 182 million miles through space. It has now gone into orbit round the sun.

#### Reversal of Magnetic Field in Superconducting Thin Films

Experimental evidence for the theory that a magnetic field reverses its direction on passing through a superconducting thin film is announced by the I.B.M. Research Laboratory of Zurich.

In the experiment thin films were evaporated on to the outside surface of a rotating glass substrate to obtain long hollow cylindrical films. These were then removed from the vacuum system and cooled to the temperature of liquid helium. They were then subjected to a magnetic field; the field which penetrated through the films into the interior of the hollow cylinder was detected by a pick-up coil placed inside the superconducting cylinder. The reversal was observed on a cathode-ray tube, which displayed both the signals from inside and outside the cylinder. Below a certain temperature a clear indication of a reversal in the direction of the magnetic field was shown, as a *phase change* between internal and external signals.

These new data would be of great value in the development of high capacity computer information storage and ultrafast switching speeds.

#### Earth's Convection Currents and Orogenic Processes

According to F. A. Vening Meinesz the forces and stresses working in the earth's crust, which



are parallel to the crust, are caused by the drag exerted on the crust by convection currents in the mantle. Such currents are caused by the cooling of the earth at its surface, which lowers the temperature of the upper mantle layer. This layer thus becomes denser and so the mantle gets unstable. By some secondary phenomenon a convection current is set in motion and this current makes about a half turn. The denser upper mantle layer is then down, and the hotter, and therefore, lighter, layer is up; the mantle stability is thus restored and the current stops. The crustal movements, caused by the mantle currents, are thus also brought to an end and the orogenic period is completed. According to the geological indications such half-turn currents last 50-100 million years.

A long period of several hundreds of million years ensues, during which the upper mantle layer cools again and the lower layer is heated up by the earth's core. A new system of mantle convection currents can again start and a new orogenic period sets in.

In view of the time that tertiary orogenic phenomena have already been going on, we can probably conclude that at present we are living in the second half of an orogenic period; the half-turn currents are no doubt still continuing. This is shown by the seismic activity.

By supposing this explanation of the orogenic processes, we do not assume that the whole earth is cooling, but only that the earth is losing heat by radiation at its surface. It depends on the amount of heat produced in the earth, e.g., by radioactive constituents, whether the earth as a whole is heating or cooling.—(Proc. Kon. Ded. Akad. V. Wetensch., 1962, 55, 327.)

### Strength of Bone

The two major components in bone are the ceramic component apatite, and the protein component collagen. The mechanical properties of bone are different from what one would expect from the properties of these components as they are studied in bulk. Thus ceramic materials are characteristically very much stronger in compression than in tension. The compressive strength of porcelain, for example, is about 100,000 lb./sq. in., whereas the tensile strength is only about 6,500 lb./sq. in. Collagen on the other hand, has low elasticity, but can, in certain circumstances, have a very high tensile strength, about, 80,000 lb./sq. in. According to J. D. Currey, in a letter to *Nature*, collagen and

apatite form a two-phase combination in bone to produce the mechanical properties shown by it.

It is known that in two-phase materials such as fibreglass, the increased strength is attained because the minute cracks, known as Griffith cracks, in the stiff fibres, which would normally spread under the influence of tensile stresses causing the whole structure to fail, run instead into the flabby matrix which will not transmit the crack but will merely deform.

The essential feature of bone from the mechanical point of view is that the apatite is in the form of very small crystals, of the size  $500 \text{ \AA} \times 40 \text{ \AA}$ , embedded in a collagenous matrix, and the Griffith cracks in the elastic apatite do not spread into bigger ones, but run out of the apatite crystals into the collagen, which will deform under their influence, without producing rupture. Thus the combination gives bone a high elasticity in tensile strength of about 15,000 lb./sq. in. and a compression strength of 25,000 lb./sq. in.

This arrangement requires that the apatite and the collagen should be bound fairly firmly together. At the moment it is not certain what forces are binding the two components. It is possible that it may be simple hydrogen bonding or though less likely, the small amount of mucopolysaccharide in bone may be acting as a cement.

According to J. D. Currey, the superiority of bone over most other skeletal materials is probably one of the main foundations of the success of the vertebrates. Invertebrate skeletons usually consist of large crystals of calcium carbonate in which cracks can easily spread.—(*Nature*, 1962, 195, 513.)

### Propagation of Microwave Phonons in Germanium

Recent work has shown that there is an appreciable electronic contribution to the shear elastic constant  $C_{44}$  in heavily doped *n*-type germanium. The electronic contribution is of the relaxation type; it depends on the redistribution of electron population in the several valleys of the germanium conduction bands when the crystal is strained.

Thus one can anticipate that relaxation dispersion and absorption will be present if the elastic constant is measured in an appropriate frequency range. M. Pomerantz *et al.* report large anelastic absorption associated with the electronic redistribution at a frequency near  $10^{10}$  cycles/sec.

The microwave phonons were generated and detected by spin wave-phonon interactions in thin films of Ni-Fe alloy evaporated onto an end of the germanium specimens. It is possible to generate both longitudinal and transverse phonons by this technique.

Two kinds of germanium specimens (single crystal bars 1/10 inch sq.  $\times$  1/2 inch) were studied, one, "pure", containing less than  $10^{14}$  donors/cm.<sup>3</sup>, and the other, "heavily doped", containing more than  $10^{19}$  arsenic donors/cm.<sup>3</sup>

Phonon propagation was studied in two directions, viz., [110] and [100]. Five types of waves could be studied, three in the [110] specimens involving the elastic constants  $\frac{1}{2}(C_{11} + C_{12} + 2C_{44})$ ,  $C_{44}$ , and  $\frac{1}{2}(C_{11} - C_{12})$  respectively, and two in the [100] specimens involving the elastic constants  $C_{11}$  and  $C_{44}$ .

The interesting feature of the results is that, although all of the waves can be propagated in pure germanium, only those waves whose elastic constant does not contain  $C_{44}$  can be propagated in heavily doped germanium. This is exactly the prediction of the theory of the electronic contribution to the elastic constants of germanium. The waves whose elastic constant contains  $C_{44}$  destroy the degeneracy of the valleys and are attenuated by the electronic relaxation absorption. There is no electronic effect associated with the waves whose elastic constant does not involve  $C_{44}$ .—[Phys. Rev Letters, 1962, 9 (7).]

#### Chloroplast Ferredoxin—A New Step in Photosynthesis

In an article contributed to *Nature* (1962, 195, 537) Prof. D. I. Arnon and Dr. K. Tagawa, of the University of California, report the isolation from spinach leaves of an iron-containing protein, localized in chloroplasts, which plays an important role in the biological production and consumption of hydrogen gas. It is found to be the most electronegative electron carrier ( $E'_0 = -432$  mV at pH 7.55) in cellular oxidation-reduction reactions. It is also the most reducing constituent which has been isolated so far from photosynthetic apparatus of green plants or photosynthetic bacteria. The properties and photosynthetic action of the chloroplast iron protein are similar to those of ferredoxin, the iron protein isolated earlier this year by Mortenson *et al.* from soil bacteria of the genus

*Clostridium*, and also obtained in crystalline form from *C. pasteurianum* by Arnon and Tagawa in their present studies. Hence they have called the spinach iron protein isolate *Chloroplast ferredoxin*. Chloroplast ferredoxin has been found to a large extent functionally interchangeable with the crystalline bacterial ferredoxin. Its redox potential, as mentioned above, is more electronegative than that of *Clostridium ferredoxin* ( $E'_0 = -417$  mV at pH 7.55).

Chloroplast ferredoxin normally functions in photosynthesis as an electron carrier which transfers electrons released from chlorophyll by light to pyridine nucleotide, which in turn serves as the electron donor for the conversion of carbon dioxide to carbohydrates. Under special experimental conditions, which included the addition of bacterial hydrogenase, the chloroplast ferredoxin was found to be capable of: (a) mediating, in the dark, a reduction of pyridine nucleotide by a flavoprotein fraction of chloroplasts with hydrogen gas as the donor; (b) mediating, in the light, a production of hydrogen gas by chloroplasts with ascorbate or cysteine as the electron donor; and (c) mediating, in the dark, the production of hydrogen gas with sodium dithionite as the electron donor.

Ferredoxins as electron carriers function in collaboration with enzymes. It may be that this action is due to its iron atoms undergoing reversible oxidation-reductions. It may be mentioned that spinach ferredoxin shows a relatively high iron content (0.815%) and a ratio of ferredoxin to chlorophyll of 1: 400.

The particular role of ferredoxin in photosynthesis, namely, that they are carriers that transfer to appropriate enzyme systems the most "reducing" electrons in cellular metabolism, that is, electrons at a potential of  $-420$  mV, has great significance. Such electrons come from either hydrogen gas or "excited chlorophyll". Hence the importance of the investigations of Arnon and Tagawa lies in their finding that ferredoxin enables chloroplasts to take electrons from hydrogen gas and transfer them to pyridine nucleotide in the absence of light. In other words, hydrogen can perform the function of light in chloroplasts that are enriched in ferredoxin.

